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PROCEEDINGS

— OF THE —

Western Gas Association

Twenty-Sixth Annual Meeting,

Indianapolis, Ind.,

1903.

Twenty-Seventh Annual Meeting,

St. Louis, Mo.,

1904.

Twenty-Eighth Annual Meeting,

Chicago, Ill.,

1905.

PUBLISHED BY THE ASSOCIATION.

1906.

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COMPILED AND EDITED

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COMMITTEE ON PUBLICATION

OF THE

WESTERN GAS ASSOCIATION.

O. O. THWING, *Chairman*.
ALTEN S. MILLER,
WM. MCDONALD,
JAS. W. DUNBAR, *Ex-Officio*.

THE TRIBUNE COMPANY, PRINTERS,
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PROCEEDINGS

—OF THE—

WESTERN GAS ASSOCIATION

TWENTY-SIXTH ANNUAL MEETING

—HELD AT—

INDIANAPOLIS, IND.

May 20, 21, 22, 1903.

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OFFICERS

OF THE

WESTERN GAS ASSOCIATION

1902-1903

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First Vice President

T. H. SHERMAN ..... Philadelphia, Pa.

Second Vice President

C. A. PERKINS ..... St. Louis, Mo.

Secretary-Treasurer

PAUL W. DUNBAR ..... New Albany, Ind.

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WM. MCDONALD	Albany, N. Y.	" "	1903
JAMES SOMERVILLE	Indianapolis, Ind.	" "	1904
PAUL DOTY	Detroit, Mich.	" "	1904
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PROCEEDINGS

—OF THE—

WESTERN GAS ASSOCIATION.

TWENTY-SIXTH ANNUAL MEETING

—HELD AT—

CLAYPOOL HOTEL, INDIANAPOLIS, IND.

May 20th, 21st, 22nd, 1903.

FIRST DAY—MORNING SESSION.

The twenty-sixth annual meeting of the Western Gas Association was called to order at 10 A. M. of May 20th, by the President, Mr. A. H. Barret, of Louisville, Ky. Secretary J. W. Dunbar, of New Albany, Ind., occupied the recorder's desk.

THE WELCOMING ADDRESS.

The President introduced the Honorable Charles A. Bookwalter, Mayor of Indianapolis, who welcomed the Association thus:

Mr. President and Members of the Western Gas Association: Indianapolis never pleads guilty to being unable to welcome and entertain her guests, and I assure you that to-day she will not be false to that record. We, in Indianapolis, are proud of the opportunity of thus extending to the members of your Association a cordial Hoosier welcome. (Applause.) We feel that as you are representatives of that fortunate element which has absolute control of 50 per cent. of the necessities of life, light and heat, and if the charges of some of our fellow citizens are to be believed, when they attempt to turn on the key at the mixer of the natural gas burner, they find you are also in control of a large proportion of the air (that other necessity), that you are especially welcome to Indianapolis. I do not intend, as one of

your delegates suggested this morning, to present to you the keys of this city, because when good people come to a good town, if they show the appreciation the people of that good town have for the good people, we have established a rule in Indianapolis of unlocking things and hiding the key for future use. I do want you to understand while you are in the city that the Gas Company is willing, and we are always willing; to extend to you the privilege of burning their products all night. (Applause.) We expect during your stay to be benefited, of course, but we trust that during your stay you will not only be benefited in a better understanding of the business which makes up your life work, but that you will be benefited by the opportunity which we intend to give you of seeing not only the beauty, but the beauties of Indianapolis. (Applause.) I know that my good friend Pearson, and that the canny Scotchman, Somerville, will not allow you at any stage of this convention to remember the fact that you are away from home, because we know that they will make you feel at home always; but I wish to say to you if at any time during your stay in Indianapolis these gentlemen are unable to secure for you that which you most desire, if you will but lodge a complaint in my office I will call out the police department and endeavor to secure it for you myself. (Applause.) You are welcome to Indianapolis, and while you are here we don't want you to forget the fact that, while you are making gas, light and heat for your sections of this, our common country, we in Indianapolis are doing the same thing, and, in addition, during our leisure hours are manufacturing books which go to entertain you after you go to your homes from the gas works. We want you to remember that Indianapolis is the center of this great State in which was born "Ben Hur;" that Indianapolis is the center of the great State where "Alice of Old Vincennes" charmed the early settlers of the southwest section. We want you to understand that in Indianapolis the gay and frisky Frenchman, Monsieur Beau Caire, first saw the light of day. We want you to understand that in Indianapolis an astute politician, the gentleman who organized the machine, the "Gentleman from Indiana," and went to Congress from the printing office was born. We want you to understand that over here in the little town of Shelbyville not only was Dorothy Vernon given to the world, but that sweetest little love tale ever told, except

the ones we ourselves have told to one particular girl, "When Knighthood was in Flower," was given to our good people. While you are here don't forget these things. We want you to talk about them when you go away; but above all things we wish you to carry away pleasant memories and pleasant recollections of the welcome the people of Indianapolis desired to extend to you. I thank you. (Great applause.)

MR. DOTY'S RESPONSE.

At the call of the President Mr. Paul Doty made the following response to the Mayor's welcome:

Mr Mayor and Gentlemen of the Association: It is surely most pleasant to be welcomed in such hospitable manner by you, representing as you do this great city; but it is something more to be welcome in a city, not merely to be welcomed, that has a gas company with the reputation of fair dealing and strict integrity that the Indianapolis Gas Company has. It certainly gives us pleasure and inspiration for our own home work, that we ourselves may make our own companies welcome in the community. I was greatly impressed by the Mayor's recital of the literary abilities of Indianapolis and Indiana, and those who have been fortunate enough to read the books must know and must feel the delight which Indiana books have given to ourselves; and we have in the person of Mayor Bookwalter a typical "Gentleman from Indiana." Now, these men you see around you as representatives of the gas interests of the Middle West are banded as the Western Gas Association. They meet annually to discuss certain problems connected with the manufacture and distribution of gas and the operation of gas works; and, more important still, we are giving thought now to the relations which should exist between the municipality and the gas company. We recognize that there is a unity of interest. If you will examine the paper list (probably you have a copy of it) you will notice a variety of subjects, one of which subjects is to treat on the question of relation of municipalities to public utility. Naturally in a meeting of this kind there are many men, and to some of these men Indianapolis means the thought of home. I was talking with a gentleman yesterday who left Indianapolis hurriedly 20 years ago; at that time he was employed in the gas

works and when he left he left his overalls. He went out to the works yesterday to look for the garments, but greatly to his surprise and disappointment the overalls were gone. You see other men around you; several of them probably lay claim to the title of philanthropist. A philanthropist is defined as one who makes two blades of grass grow where only one grew before, so the baldheaded gentleman over there can fairly lay claim to being a philanthropist, since he makes two shares of stock grow where only one grew before. He truly is a philanthropist. This meeting has two sides naturally—serious and business ones—but our main purpose is given to the discussion of papers and the exchange of ideas, and on the other hand is another side—the pleasant one; and certainly no one who has had the pleasure of listening to your welcome can feel anything else than that a genuine hospitality has been extended to us—a typical Hoosier welcome. (Applause.)

PRESIDENT BARRET'S WELCOME.

THE PRESIDENT—The next thing in order would be the President's address. I want to take this opportunity of thanking the Association for the honor extended to me by my election to fill this office at your last meeting in New Orleans during my absence. That absence was unavoidable on account of emergencies. It has been an established custom of the President to present an address to the Association. In considering this practice, and looking over the work of my predecessors, searching for ground that was acceptable for such an address, I came to the conclusion that, owing to the thoroughness of the research of my predecessors, little or nothing is left for me to say, nothing having occurred of striking interest since your last meeting. I, therefore, concluded that the best interests of the Association would be covered by spending the time usually occupied in the President's address in listening to the papers and to the discussions thereon. I report to the Association that; since your last meeting, we have lost by death Mr. E. H. Jenkins and Mr. Julius Buss. The next order of business is the

REPORT OF THE BOARD OF DIRECTORS.

The report was read by the secretary as follows:

INDIANAPOLIS, IND., May 20, 1903.

To the Members of the Western Gas Association: The annual meeting of the Board of Directors of the Western Gas Association was held in the Claypool Hotel, May 19, 1903.

The meeting was called to order by the President, Mr. A. H. Barret, with the following members present:

O. O. Thwing, Thos. D. Miller, J. B. Howard, Paul Doty, John Gimper, Wm. McDonald, Jas. Somerville, J. W. Dunbar.

On motion of Mr. J. B. Howard the following papers were accepted for presentation to the Association.

Low Candle Power Gas, by Capt. Wm. Henry White.

Wrinkle Department, by Mr. W. E. Steinwedell, Editor.

Gas and Meters, by Mr. John McIlhenny.

Maximum Economical Yield of Gas per Pound of Coal Carbonized, by Mr. James Somerville.

Report of the Heat Conductivity of Different Clays, by Mr. H. A. Wheeler.

The High Pressure Gas Main under the Mississippi River at New Orleans, by Mr. Thos. D. Miller.

Increasing Gas Sales to Present Consumers, by Mr. B. W. Perkins.

Naphthalene, by Dr. W. H. Birchmore.

Municipal Ownership of Public Utilities, by Mr. A. E. Boardman.

Quadrupling the Capacity of an Ordinary Purifier House at very Small Cost, by Mr. F. H. Shelton.

The President appointed the following Committees:

On Auditing.—Thos. D. Miller, John Gimper, Paul Doty.

On Introduction of Visitors.—J. B. Howard, Jas. Somerville, O. O. Thwing.

On Membership.—Wm. McDonald, F. H. Shelton, Geo. F. Goodnow.

On motion of Mr. Thos. D. Miller the Secretary was instructed to draw on each member of the Association who may be delinquent for dues on August 1, 1903.

On motion of Mr. Thos. D. Miller it was passed that recommendations be made that Article 7 of the by-laws, providing for an annual meeting of the Executive Committee, be repealed, and that the President assume the duties now performed by said Committee.

On motion of Mr. Wm. McDonald it was decided to recommend to the Association that no person shall be elected an Honorary Member of the Association unless the name be first submitted to the Board of Directors and recommended by them to the Association.

REPORT OF SECRETARY AND TREASURER.

Mr. Dunbar, as Treasurer, reported a total receipt for the year (including balance of $85.23 from 1902), $1,881.23, an expenditure of $1,343.78, and a balance of $537.45.

As Secretary, Mr. Dunbar reported a total membership, May 1st, 1903, of 379.

On motion, the reports were adopted and the recommendations contained therein were agreed to.

The Secretary read the following invitations:

INDIANAPOLIS, IND., May 18, 1903.

Mr. James Somerville, Engineer and Superintendent, Indianapolis Gas Company, City: Dear Sir; Your esteemed favor of 16th inst. duly received. It will afford me great pleasure to place my private car at the service of the ladies and gentlemen of your party, upon the occasion of the meeting of the Western Gas Association at the Claypool Hotel in this city, 20-22 inst. Kindly inform me upon which of these dates you wish to use the car, also the hour.

In these days of wonderful achievements in the gas field, I scarcely thought you would resort to trolley locomotion, but would use instead some inflated means of transportation.

Again assuring your organization that it affords me great pleasure to be of service to them, I am, Yours very truly,

HUGH J. MCGOWAN.

INDIANAPOLIS, IND., May 19, 1903.

Mr. James Somerville, City: Dear Mr. Somerville: On behalf of the Commercial Club I take great pleasure in extending through you, to the delegates to the Western Gas Association, a most cordial welcome to the city and the privileges of the Club during their stay in the city. If you desire or think it necessary,

I will take pleasure in furnishing each of them a visitor's card which will entitle them to the Club rooms. Awaiting your pleasure, I remain, Very truly yours,

LEWIS HOOVER, Secretary

On motion of Mr. Howard the invitations were accepted, with thanks.

Chairman J. B. Howard, on behalf of the Committee on Introduction of Visitors, invited the visitors to share in the proceedings, and assured them that the Association would welcome their voices as well as their presence.

The President named as the Committee on Place for Next Meeting, Messrs. F. H. Sheldon, E. G. Cowdery and Geo. D. Roper, directing them to report Thursday morning.

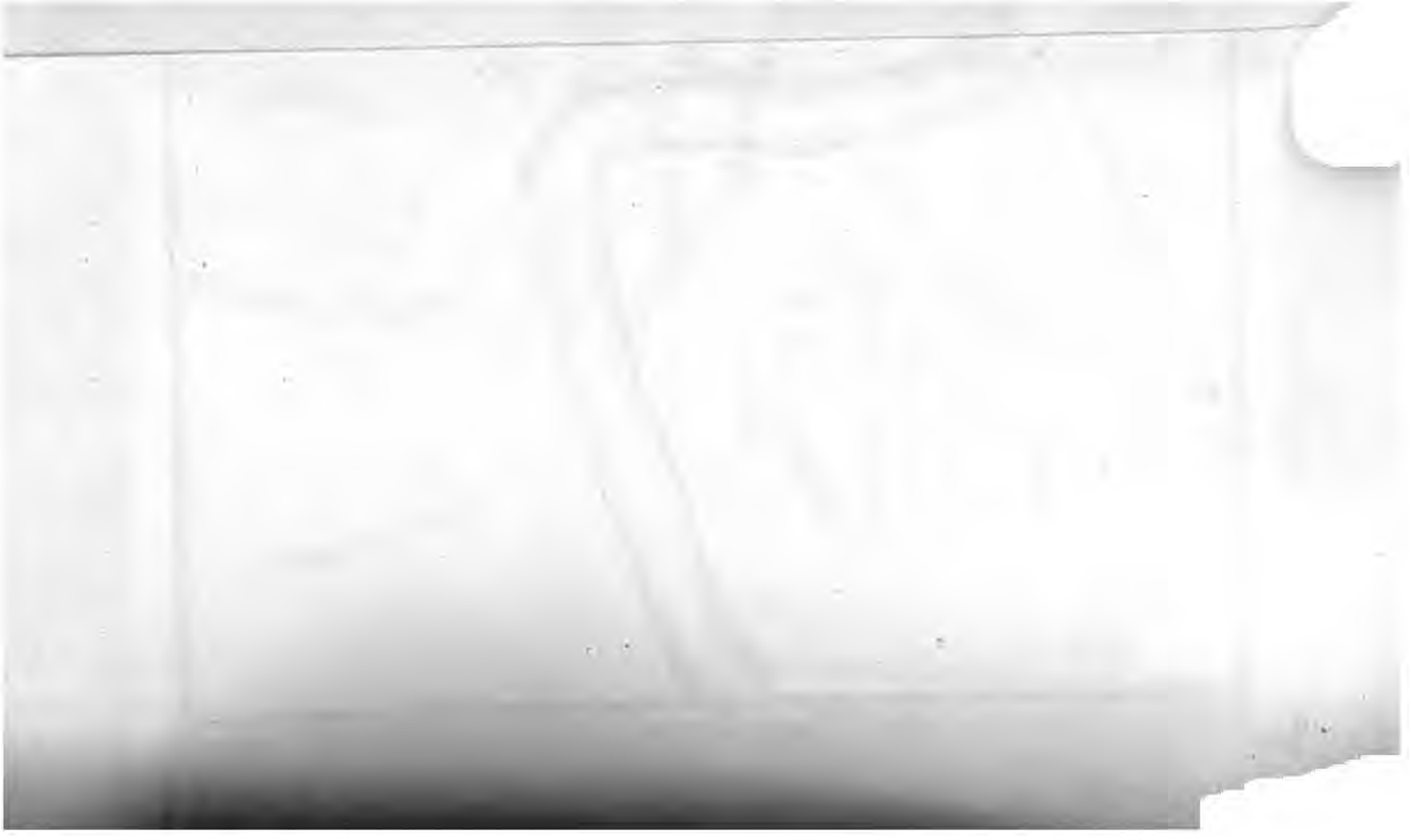
The President then introduced Mr. Thomas D. Miller, of New Orleans, La., who read the following paper on

THE HIGH PRESSURE GAS MAIN UNDER THE MISSISSIPPI RIVER.

The distance from Cairo to New Orleans is 868 miles, and the fall of the river in that distance is 278.74 feet, or about .32 feet per mile.

The lowest water known at New Orleans was 0.43 feet, on the Canal street guage. The zero of this guage is 2.53 feet below mean Gulf level. The highest water known prior to this year was May 7th, 1897, when this gauge showed 19.5 feet. The past spring (1903) the gauge showed 20.3 feet on March 29 and 30, with a terrific current flowing. The Mississippi river has the reputation of being extremely fickle throughout her entire course, and the barrels of money spent on her banks by the National and State governments have not accomplished more than to confine the channel through specific stretches. For miles and miles above and below New Orleans the low, flat plantation lands are protected by levees, many miles of which are protected from the current by piling and sheeting, or mattress work; but for this the river might move over several miles in this section of the country during high water times.

It having been decided to supply Algiers with gas furnished through a high pressure main laid on the bottom of this river, old and experienced river men were asked as to various points



involved in the proposed work, and several engineers were consulted, but the majority of them regarded the plan as unfeasible.

The reasons assigned were:

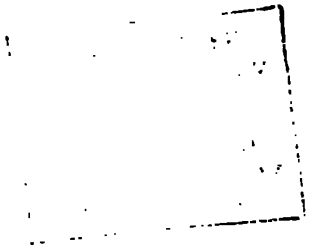
1st. The extreme depth of the river; 2d, the constantly shifting bed of the stream; 3d, the swift current in the main channel; 4th, the fact that in the bed of the river lies the wrecks of any number of crafts of all characters.

In the selection of a point for laying the pipe, of course, permission of the Port Commissioners had to be obtained. The head of Julia street was selected because it was conveniently located for the high pressure main leading from the works. There was no special dock constructed at this point. The levee was low here and the point in Algiers immediately opposite was a desirable one to enter. Last, but not least, the Port Commissioners were willing that the pipe should be installed at this place. The accompanying drawings show the location and profiles. (See Nos. 1, 2, 3, 4, 5, 6, 7, 8.)

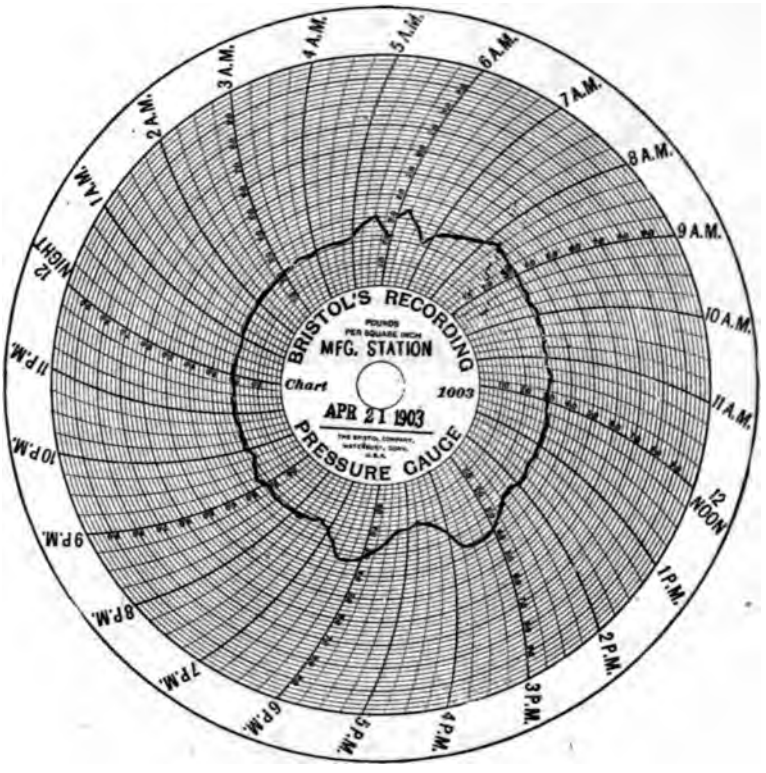
The description of the work of laying the high pressure gas main under the Mississippi, at New Orleans, is given to you as Mr. W. D. Marshall, Superintendent of the plant; and Mr. M. L. Goldman, his draughtsman, gave it to me. Mr. Marshall was in charge of this work, under the direction of Mr. C. T. Sloan, whose experience has fitted him to take charge of a work so unprecedented in its character.

Having located by soundings the exact point at which the pipe was to enter the water, the power to be used in pulling the pipe across the river was considered. The consideration of locomotives was abandoned owing to local conditions. A large derrick boat, with modern machinery was engaged. This boat had a capacity of lifting, on a straight pull, 75 tons. All of the pipe and protecting sleeves were taken across the river to a point near where the pipe was to enter the water. A ditch was dug at the point selected at right angles to the water line, and as this side of the river bed is very steep, no trouble was anticipated from the friction on the bank after the pipe was once started into the water. Fifty feet from the water's edge the sounding showed a depth of 60 feet, while 250 feet out there was a depth of 120 feet. A length of pipe about 250 feet long was then screwed together, each joint being screwed up as tightly as possible, four pairs of extra long and heavy pipe tongs of lathe pattern being used. It

No. 1.



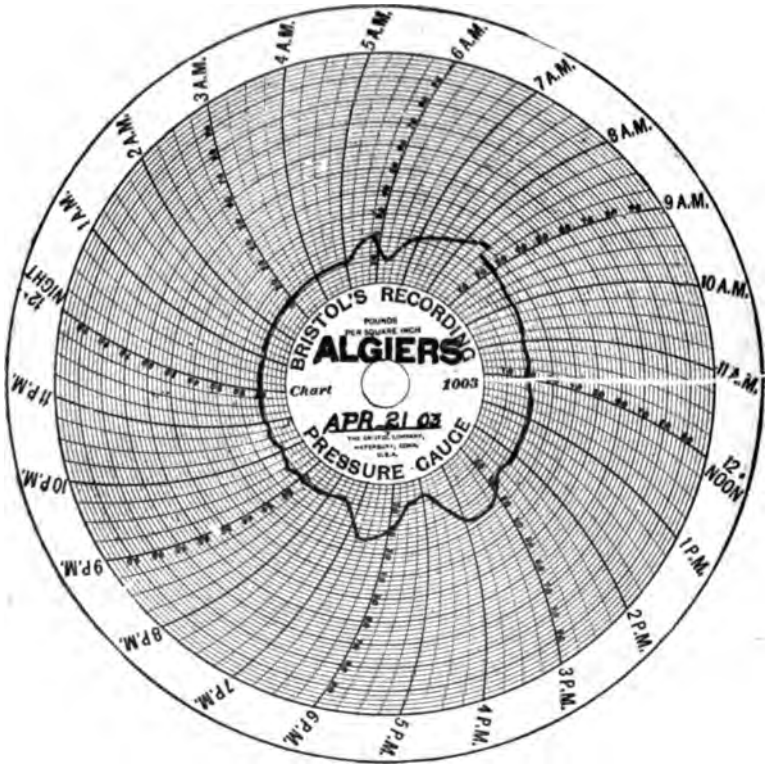
was considered extremely important that the threads should be entirely taken up, and that no threads should be crossed; because in hauling on the cable to draw the pipe line across the cable, by untwisting as the strain came, tended to loosen the joints by starting the threads. Each joint was coated on the threads with asphaltum iron paint, for the double purpose of preservation and preventing leaks. Each coupling was inclosed in a split sleeve of



No. 4.

cast steel, weighing about 300 pounds, about 3 feet long, and held together by eight ⅝-inch by 4-inch bolts, with washers at each end; the bolts being split at the end to rivet them on. The first 3 sleeves were screwed as tightly as possible, and the remainder moderately tight, in order to allow some little play. The shore end of the pipe was kept closed with a short length of pipe with a plug in it. This was done so that in case the pipe got into the river it would not fill with water.

The water end of the pipe was a short length of pipe with a solid coned end, about 1 foot long, having at its end an eye to which was shackled the hauling end of the cable. The cone was intended to cut through obstructions which would otherwise stop it. The pipe itself was the best 6-inch, Allison, upset end, steel pipe. The threads were specials, and were made plus, being on the collars, so that the threading did not weaken the pipe at all.



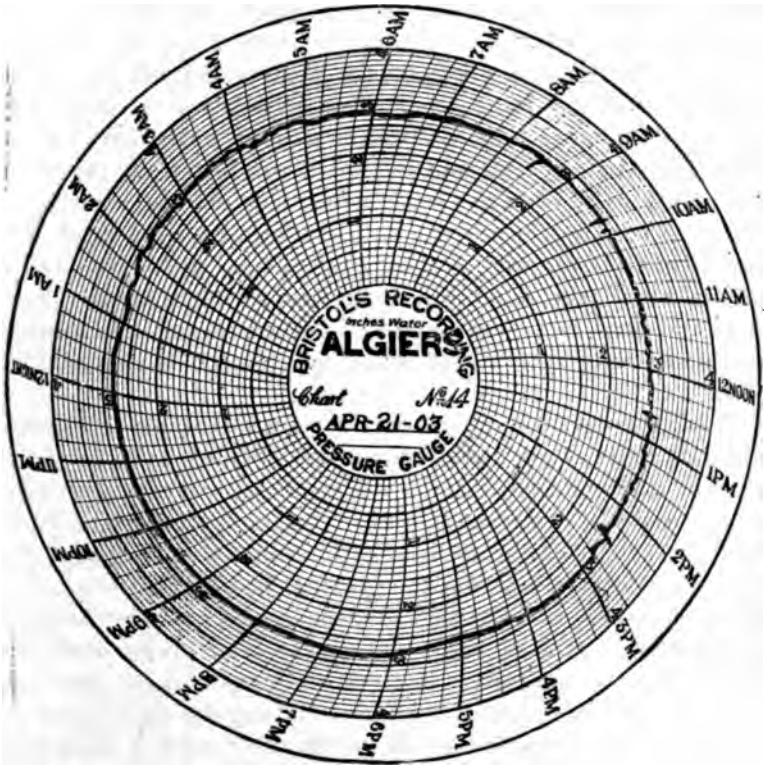
No. 5.

The threads had an extra taper and the ends of the pipe were faced, and were intended to set flush with the end of the next joint. A stout post was set up near the line of the pipe, and a line was taken around the pipe about 20 feet from the end, and a turn taken around the post, so as to snub the pipe as it went into the water.

The cable used in hauling the pipe, made by Roebling's Sons Co., was the best steel wire cable on the market, with a breaking

strength of 120 tons. Part of the cable was 1 inch in diameter for the lighter pulls, and the remainder was 1¼ for the heavier pulls.

The cables were joined by coned ends and shackles, and reeled up on the side of the river opposite to where the pipe was ready and a brake arranged on the reel. The end of the cable, with plenty of slack for connecting with the pipe, was put on a barge



No. 6.

and made fast by chain grips. The barge was then taken in tow by a tug, and the cable guided across the river in as straight a line as possible, a range being taken which took into account the current, etc. When near the shore, a second tug came alongside the barge and pushed it to the shore. The end of the cable was immediately shackled to the end of the pipe line, and the cable cast loose from the barge and thrown overboard. All was now ready for pulling. The first attempt to take the cable across

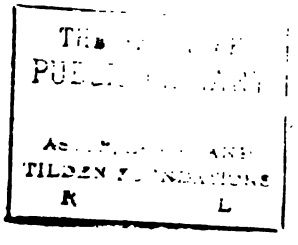
failed because of some carelessness in the winding of the cable on the reel. The second time the cable was wound, boards were put in lengthwise to the reel so as to give a snug, neat coil, and also to keep the shackles from fouling. The brake was discarded and boards used as a hold-back on the edge of the drum.

When the far end was made fast to the pipe line and everything was in readiness, a fall was hitched to the cable with chain grips and hauled taut, acting as a stopper, and the cable was unreeled to the next shackle and unshackled and led into the drum of the hoisting engine of the floating derrick, on whose deck the work was being done. This derrick was securely tied up to the shore and the reel strongly secured to the derrick. A trench about 8 feet long was dug about 250 feet from the shore line and parallel with the water edge, and two large pieces of timber, 8 inch by 16 inch, put into it, and a second ditch dug towards the river and a short cable passed with a round turn around the timber, and the ends clamped with special cable grips. A second short cable was hooked on to the first and taken along the ditch to the water's edge, and a large snatch block shackled to it.

When all was ready the cable was passed through the snatch block as a fair lead to the drum of the windlass and the signal made, "ready to haul," which was answered from the other side, and the haul was then made. When the end of the pipe came near the water's edge, the signal was made, "stop heaving," the plug end was then removed and the next joints of pipe screwed on in succession, and the plug joint replaced for another haul.

The first hauls were easy, and unless obstructions were met with, offered no difficulty. Some obstructions near the shore on the pipe side gave some trouble, necessitating the use of a luff on the cable. This was hitched on to the cable with a chain-grip and taken to the bitts and a rope taken around the gypsy on the windlass and hauled in. The large sleeves seemed to be the thing which caused the trouble, and the first two or three had apparently cut their way through timber obstructions, the others having followed readily.

The pulls became heavier and heavier as the line entered the water. The cable was then stoppered, and the snatch block taken from the end of the line on the dead-man. The line was shortened in until about 200 feet from the bank of the river, and an


TILDEN

extra heavy 22-inch two-sheave block hooked on. A second block with three sheaves (only two sheaves were used in hauling, no heavier pulls being required) was gripped on the cable. A cable was then rove on these large blocks, and the hauling part leading from the fixed block was taken down to the windlass through the snatch block, the position of which had been reversed. The cable was then hauled in. When the luff came two blocks, the large block was hauled back for the new pull by the gypsy.

When the line of pipe was just outside the hull of the derrick; the cable was stoppered, then slacked from the shore side and taken around under the barge, which was done an account of the construction of the wharf and the levee at this point. When all was ready again and the cable gripped for hauling the stopper was eased off and the line of pipe hauled out of the river right through the mud of the bank and about 15 feet from the water's edge, apparently in excellent condition. About 15 feet of the line was hauled out of the New Orleans side of the river, and it slipped back when the tension was removed from the cable. The work was considered successfully completed at this point.

The cable was taken across and attached to the pipe line at 5 P. M., Saturday, June 28th, 1902. The first haul was made about 6 P. M., and the end of the line came out on the New Orleans side at 10:15 A. M., Monday, June 30th, making the total working time of connecting up and pulling the pipe into the water about 32 hours. No work was done Saturday night after the first pull was made, but was resumed Sunday morning at daylight and continued straight through till the pipe was brought out of the water Monday forenoon. Twenty-one hundred feet of cable reached across the river, and about the same amount of pipe was used.

The point of entering on the Algiers side is about at the continuation of Newton street. On the New Orleans side, the pipe enters the river about 100 feet north of Julia street.

The peculiar shelving formation of the bottom of the river on the New Orleans side is shown by the profile, reaching out 220 feet from shore. At this particular point the current is up stream, the result of an eddy. The neutral line is out about 200 feet. This profile was made showing the bottom of the river at the pipe line and above and below the pipe, gradually diverging

from the dock line at *A* until at *E* the soundings above and below the pipe were 20 or 25 feet from the line of the pipe.

One of the conditions of the permit of the Port Commissioners was that the pipes on the New Orleans side should be placed 25 feet below low water at the dock line, and 30 feet on the keel, as this was the site of a proposed dock for ocean steamers. When the work was finally completed the pipe was 10 feet below low water at the dock line, and about 15 feet on the keel, the Board having consented to let it go at that with the specific agreement that the pipe would be lowered when the Company was notified to do so. The low pressure line was partially down in Algiers, the governor station was completed and gas was turned on in the Algiers district early in November, 1902, and consumers were being taken on rapidly. About 10 days or 2 weeks after the gas was turned on, the Engineers of the Board of Port Commissioners, Messrs. Coleman, Malochee and Villere, notified the Company that the contract was let for the construction of the new dock, and that the lowering of the pipe should be proceeded with at once.

A large sand dredge was secured to pump the earth from beneath the pipe and thus permit the pipe to settle. In order to keep gas on all the time, and yet have a flexible connection, a section of pipe above the water was removed, and the pipe extended up to the dock level, and connection was made with 16 feet of heavy 2-inch boiler hose. This was accomplished in two hours. The dredge was put to work in shore and gradually worked out toward the channel, the work being directed on reports of a diver. This work was continued for three weeks, when we had the pipe all clear to *D*, but it had only settled about 4 feet. The pipe was free and could be swung by hand back and forward, but it would not go down any further. The river had been rising quite rapidly, and the work had to be abandoned for the time until low water. The 2-inch hose has been doing service all the time, and for more than two months past has been entirely submerged in the flood which has been rushing past.

The fractional profile was made from report of diver Schnell, and sounding taken by C. W. Wood, C. E., the latter part of January, 1903. The diver reported the pipe covered with soft mud from the point *A* to about the location *B*, but the trench excavated by the dredge still remained to a great extent and was

readily followed. From *B* to *C* the pipe was exposed, and in fact was from 1 to 3 feet clear of the bottom. The distances are only approximate, and are based on soundings and general conditions. The diver reported that at some point between *C* and *D* he found a decided ditch with a rise of 8 or 10 feet, the face of which is very steep, and he is under the impression that this indicates some wreck or other obstruction. These irregularities between *C* and *D* would seem to indicate some obstructions, but when the stage of the river is considered and the fact that, at about the places mentioned the current and eddy meet, it would be difficult to state just what conditions these varying cross currents might produce.

When the pipe was being pulled across the river, and the end was in the neighborhood of *D*, it looked for a while like it would have to remain there, for the full power of the engine with threefold block and tackle was stalled.

The cable smoked alarmingly and showed signs of sparks on the winding drum. A luff was used on the cable and the obstruction was pulled through. When the end of the pipe was brought on to shore pieces of timber were found wedged in between the bolts, and the sleeve and some of the short ends of the bolts were bent over as though they had been struck several blows with a sledge.

When the dredge boat weighed her stern anchor, which was buried in the neighborhood of *D*, an old hog chain was pulled up evidently from an old wreck. I think, therefore, that the conclusion is perfectly warranted that the pipe is resting on an old wreck somewhere in that locality.

I should state, by way of explanation, that the pipe shown on the profiles is only approximate. The pipe at *A* and *B* is exact, and the soundings for the pipe were made at the time the other soundings were taken. The elevations of the pipe at *C* and *E* were taken just after the completion of the laying of the pipe, and I have reason to believe that at the points *C*, *D* and *E* the pipe is now touching the bottom.

The service in Algiers is now entirely satisfactory. We have in use a combination regulator and governor. The accompanying cards show the pressure at the works, and on the high pressure side of the Algiers governor, and on the low pressure side of the governor. Wet meters cannot be used because the gas is so

dry after being compressed, that it literally drinks the water from a wet meter in a few days.

We have had no trouble from water in the river main since pressure was put on. When the main was first laid and both ends were open it served as an excellent speaking tube, and conversation was held through it.

Mr. Miller, at the close of the paper, said he took it for granted everyone knew that the laying of this main was the scheme of and done under the general direction of Mr. Shelton.

DISCUSSION.

THE PRESIDENT—We have heard a very interesting paper detailing a unique experience in providing for the distribution of gas. I should like to have it properly discussed and the new points taken up in connection with the difficulties mentioned by the writer. Mr. Shelton, you are familiar with this work.

MR. SHELTON—Two or three points, I think, might be added to the paper to make the record complete for those who may want to refer to it later. The cost of work, for instance, is always a matter of interest, and this pipe in question I can say, in round numbers, cost $10,000 to put under the river. It is 2,000 feet or over in length, and it cost somewhere around $5 a foot, laid. The pipe was put across the river to avoid building a separate works in Algiers, which has a population of 15,000 or 20,000. They were ripe for gas, and a suitable plant (outside of distributing pipes and meter service) would cost about $25,000 or $30,000 for the present and some future years. This 6-inch wrought iron pipe to conduct gas at high pressure was with the idea that at high pressure it would be able to furnish as much as a million feet of gas across the river. A 6-inch main at high pressure is by no means necessary to conduct the gas which will be used there for some time; but for stability, something tangible to handle, it was thought better to use a 6-inch pipe than to come down to a 5, 4 or 3-inch. I want to call special attention to the charts Mr. Miller inserted in his paper showing the steady pressure condition that we find. The pumping plant at the works accumulates and maintains 15, 20 or 30 pounds dur- the 24 hours, according to the conditions, on the high pressure pipe system. Sometimes the pressure may be 15 pounds, or it may

be 30—it more or less follows that range of irregular pressure through the high pressure mains—but no matter what the pressure may be or the fluctuation of intensity on the high side, the governor does practically and substantially perfect work, and the pressure stands at 30-tenths on the far side of the river night and day. A question of particular interest in going under such depth of water was that, with a low pressure pipe, it would be extremely difficult to take care of condensation, but high pressure would operate with less difficulty in deep water, because the tendency of high pressure gas, in the first place, is not to drop any liquor (that having been squeezed out in the works), due to the compression and to the fact that in any release of gas at high pressure the tendency is to absorb and pick up—the reverse of the effect of compression; and we felt that the high pressure pipe being some distance from the works and would operate, as a matter of fact, entirely dry, as far as any condensation from the gas is concerned, and in the several months in which the pipe has now been working I think such has been the result. Am I right, Mr. Miller, in saying that not a drop of liquor or moisture has been observed in the pipe, and that the high pressure seems to eliminate the question of drip in the pipe under the river?

MR. T. D. MILLER—That is right.

THE PRESIDENT—We would like to hear from Mr. Norris.

MR. NORRIS—I would like to ask whether, in the case of the pipe across the river as finally settled, there is now any tension on the pipe at the shore ends? In other words, as the pipe now lies, has it settled to a bearing on the bottom, or does the current tend to pull it away from the banks? I would also like to ask about how much did the pipe bend down stream before coming to a final bearing—*i. e.*, how far did the current carry the middle of the pipe down stream from a straight line between the two points of entry? I cannot say anything of value in the way of a discussion of this paper, but I would like to express my appreciation of the courage of the New Orleans management in undertaking this job, and the engineering skill with which they have solved a most unusual problem under very unusual conditions. I would like to ask Mr. Shelton how they plan to get rid of any accumulation of water in the bottom of this river pipe if, eventually, there should be any accumulation? I appreciate that the gas entering the pipe is unusually dry, but there might be condi-

tions under which this pipe would get trapped by water, and I am sure this is a possibility which he has some plan for handling if the need for it should arise. I suppose any accumulation of water could perhaps be blown out by pressure, the town being in the meantime cut off and run from the expansion of the gas in the mains while the river pipe is being blown out.

MR. SHELTON—This is Mr. Miller's paper. I think he can better answer these questions than I can.

MR. GOODNOW—All people who attempt high pressure, and especially in our western country and around Chicago, feel a great deal of interest in this matter of submerged high pressure pipe, from the very fact that at New Orleans it must be about as difficult a thing that could be brought into use by any company; and, therefore, if this is successful we would feel perfectly safe in attempting such installations under smaller streams. For myself I never had that obstacle to contend with to any great extent, and so cannot speak of any difficulties that might be encountered. I know several small streams that it will be necessary to cross, in our district, but they will be mere brooks compared to the Mississippi river, so I think we can all feel at ease in the matter; that we can accomplish this without any difficulty whatever. I have not heard from Mr. Miller as to whether there was any question of electrolytic action on the pipe at New Orleans. I should think that the ground near the river would form an excellent circuit, if the trolley currents or the wires of the trolley lines were in such position as to come in contact with his pipe line, and whether any method of installation has been adopted to cut this out. We found in our work corrosion of pipe by the current from the trolley lines, and we spent a great deal of effort, some money, and a good deal of worry in trying to find out just how to prevent this trouble. I think it is a question that will be the more serious because of the conductivity of a high pressure pipe, unless some means of insulation can be used to cut up and prevent the accumulation of the trolley current in returning to the power station. The method that seems to be most effectual is by cutting up the current by such insulating at different points as is found desirable from the volume and strength of the current running on the pipe. There are two methods by which this can be accomplished. The trolley people will tell you to bond your pipe to the rail somewhere near the power station, which will

make the connection between the wire or the return into the station, and thus prevent action. This is very true at that point, but at other points a sleeve, or valve or joint will be affected by this action all along, and instead of localizing the action at or near the power station or sub-station it will undoubtedly extend the flow, maybe throughout the whole line. We have reached the conclusion that we would rather localize the points of danger than to bond to the rails the return in that way. We have been at some trouble, and consulted several electrical experts in Chicago and Boston, and have worked under their advice. In doing this we adopted the second method instead of bonding to the rails at any point, and that is why I would like to inquire of Mr. Miller if he adopted any arrangement of that kind for the river line or for his entire high pressure system. The question of dry gas within short distance from compressors is confirmed, I think, by all people who have operated high pressure lines. I contributed a wrinkle for Editor Steinwedell's department, showing the diagram of a drip located about 500 feet from the compressors. We never found any water to mention beyond this point. Before we put this in it travelled a little farther and we were unable to get it out, but about November or October we adopted the drip, and were then able to eliminate it and found nothing beyond this point. We were not troubled with any water or frost in service pipes, although we had 200 lamp posts on this line. The question of the cost of this line compared with the cost of a low pressure line for conveying gas across the Mississippi would be a small fraction, provided you wished to convey a million feet across the river. It would undoubtedly take a 16-inch pipe, and several times the cost. As to the question of the amount this will convey, I think Mr. Shelton's estimate of one million feet is very low. I know of a plant near Chicago with a 6-inch line 6 miles long, conveying 1,200,000 feet in 24 hours with an initial pressure of 30 pounds, and losing 8 pounds pressure in that distance.

THE PRESIDENT—We would like to hear from Mr. Rice.

MR. RICE—I am greatly interested in this paper because it accomplishes on so magnificent scale what I had attempted on a very small scale, at Norfolk, Va. Across the river from Norfolk is a small town of about 5,000 people. We decided to attempt to supply it by laying a high pressure line under the river. On

account of certain local conditions we finally settled on lead pipe, if the same could be accomplished. We laid a lead pipe, between 600 and 700 feet long, with a capacity which figures out about 8,000 feet per hour, and it does better than that. That pipe has been in use a year and is giving perfect satisfaction. The pipe was pulled across the river in half an hour. It was put together on a large barge in 12 hours' time by one plumber. The joints are stronger than the pipe itself. The pipe was simply laid around on the barge so as to have no kinks. The barge was pulled across the river. As I said, it was laid in about half an hour's time, coupled up at both ends and completed. At present we are putting about 2,500 feet an hour through it. The pressure is scarcely noticeable; I should say 2½ pounds. It goes into a small holder on the other side of the river, which gives us a reserve in case of accident; but we have not had any accident. The pipe cost us 33.8 cents a foot, and the cost of laying it, was, as you see, purely nominal. The pressure of the pipe is given by the manufacturer as 600 pounds, and as we have a working pressure of 3 pounds, we have a pretty good margin of safety. On the question of drip we have not found any difficulty yet. The gas is perfectly dry and never accumulates any moisture. It seems to easily solve the question of supplying a very small town across a stream of water. I think the river is 33 feet at its deepest point. The current is very swift, probably running there 7 or 8 miles an hour.

MR. MILLER—When the pipe was first laid, at the point where you notice on the profile, between 2,100 and 2,200 feet is the mattress work. When the pipe was finally let into the ground and settled there was a bend in it of about 35°. Right there was a joint and the strain on that joint was too great for it. It broke the cast steel sleeve and pulled the coupling in two. The leak had been going on up to the time the pressure was put on. When pressure was put on it showed gas coming out, but it did not show until we had blown the water out of the pipe. Probably 40 or 50 feet of pipe was filled with water. We put an air compressor on the New Orleans side and ran up the pressure to about 60 pounds, then opened the valve on the Algiers side and let her go. Considerable alluvium went out with the water. Since that time we have had no water at all. To repair, the pipe was cut in shore, a derrick raised it out of the water, the

broken coupling was taken off and a new one put on. The others were found perfectly intact. The pipe was then heated inshore from this sleeve until it bent enough to give just the angle we wanted, and then lowered it back into the water. We have had no trouble since. We did provide a large tank on the Algiers side, so that in the case of any accumulation of condensation or water in the pipe that would be sufficient to resist the flow of gas, the pressure could be run up and the water blown out into the tank. Then it could be drawn from the tank by simply opening the drain pipe and letting the pressure force it out. There is a tank of similar character on the New Orleans side. The pipe enters the tank at one end and leads out at the other so that any condensation coming in there it will drop down in it. There has been little gotten out of this tank. Regarding electrolysis, I have not had any evidence of it on any of the pipes in New Orleans. I have never made an electrical examination and I doubt very much if we have very much on our pipes. The ground is so constantly saturated with moisture, I believe, from the character of the soil and the amount of moisture that it carries, that it is a pretty good conductor itself. Besides, the power stations of the the street car lines are pretty well distributed over the city, so there is no great concentration of current coming to any one section of the town. As far as electrolysis in the river goes, I cannot see how there could be any, as there are no electrical lines connecting the two cities. I think the telephone company has a cable across the river, and besides that the pipe line is the only connection between the two towns; no bridges or anything of that sort of course. I cannot say, and nobody else can say, just how much that pipe swings down stream. It was pulled across at a fearful tension, but of course there was something of a tendency to swing from a vertical plane at the time because of the current. There are places which we know are 5 or 6 feet above the ground, and I have no doubt the mermaids hang their clothes out to dry on that pipe every day. The tension on that pipe would be practically nothing. There is a certain bending moment in some portions of it in the bottom of the river. I think the tendency would be to gradually fill up under the body of that pipe, and finally probably the pipe will be entirely covered. During this high water the up stream current in this eddy, which extends five or six blocks

down the river where the ferry landing is, is very erratic. The ferry boat in going across and coming back will encounter an entirely different condition from that which it found on the prior trip. On our high pressure lines at different points we have put in, in a district where there is a large quantity of gas going, a drip pot or drip tanks. We thought we were going to get a good deal of business there, but we didn't. Very little condensation will accumulate. In the combination governor and regulator spoken of, the regulator brings the pressure from 30 or 40 pounds, or whatever the pressure is, to about 8 or 10 ounces. Then the governor brings it from that down to ⅛ to ⅛ on the other side. All of our stations are provided with blow-off tanks so that when the gas pressure gets high, or beyond a safe limit, the gas will blow off instead of bursting the leather diaphragms.

THE PRESIDENT—Gentlemen, I think we have had a very nice discussion upon the experience of Mr. Miller in New Orleans, and a vote of thanks would be in order.

On motion of the Secretary, a vote of thanks was tendered to Mr. Miller.

THE PRESIDENT—The next paper on the programme is that on "Low Candle Power Gas," by Capt. Wm. Henry White, of New York.

CAPT. WHITE—Mr. President and Gentlemen of the Association; It is quite an unusual situation that obliges me to offer an apology, for I believe I have performed my duties as a member of many Associations. As most of you are aware, after a serious illness I was sent abroad. I have been back in our country scarcely a month. Fully half of that time has been devoted to professional work in the service of one of the larger gas companies. I also found that my office building had passed into the hands of new owners, who are going to tear it down and replace it with another "skyscraper;" therefore, the search for offices was forced upon me which proved to be a time consuming and exasperating job. Feeling that the time had passed when one could come to these meetings with the crude material of a paper stowed away in his head, and over night put it into shape for presentation, and the further fact that the doings of our Association are now carefully scanned in Europe as well as this country, combined to make me feel that it would not be either fair to the Association or just to myself to appear here with any such sort of

line of thought. Therefore I have to apologize for the fact that I have no paper to offer, and I ask you courteously that I may continue this subject until our next meeting, when I certainly will be prepared. I have found in the time that I did have to consider the subject of my proposed paper that, while for years I had been on record, in discussion, as an opponent of extreme high illuminating powers, that the subject has been taken up in Europe, was being very actively discussed there by the ablest minds in our profession, as well as here among ourselves, and I felt that I could not afford to write a paper that I did not think would stand a fair chance of being at least approximately equal to those that have from time to time been contributed to this Association. Under the circumstances I knew I would rather make before you an apology fortified by an explanation than to present a paper which could be justly criticised as incompetent and unworthy of the occasion. I, therefore, feel that I am doing you the best justice in this matter by simply making an apology and asking your consideration. I trust I may have the privilege of holding the subject my own until next year.

THE PRESIDENT—We all regret the lack of the Captain's paper, which untoward happening is due to the misfortune of ill health. We will hold him to his promise.

The President introduced Mr. John Somerville, of Indianapolis, who read the following paper on the

MAXIMUM ECONOMICAL YIELD OF GAS PER POUND OF COAL CARBONIZED.

Your committee have done me the honor to ask me to start the discussion on what is the "Maximum Economical Yield Per Pound of Coal Carbonized." There can be no question that there is a maximum useful yield; a point where the cost of producing the gas is more than the value of the gas produced. I doubt if it is possible, owing to varying conditions, to say where that point is; some coals requiring for their proper distillation a higher or lower temperature than others.

Then there is the question of candle power, the standard of which varies in different localities. The variations, therefore, will not permit us to lay down any hard and fast line as to the proper degree of heat that will produce the best results, so that

to some extent the question is one of locality. Yet, although these varying conditions exist, the question still presents itself, "How far is it profitable to force the distillation of the coal we are using?" Speaking from personal experience extending over a number of years, I have found it profitable to limit my yield from the coal I use (so-called "second pool" Youghiogheny) to 4.70 and 4.75 cubic feet per pound. This yield will give about 17 candles, varying somewhat with the state of the outside temperature, and requiring from 5 to 7 per cent. of cannel to bring the candle power to the required standard of 18. Desiring, as all of us do, to increase the yield, and thereby to effect a saving in the coal, I have at different times increased the heats until the make rose from 4 75 to 5 feet per pound. Taking the cost of the coal at $3 per ton, this extra 500 feet gained effected an apparent saving of 15 cents per ton of coal carbonized, and on the year's supply of say 23,000 tons, amounted to the respectable sum of $3,450. If this increase of yield could be shown to be clear gain then you will agree with me that such a saving is a consummation devoutly to be wished. But I have found from repeated experiments in this direction that the extra 500 feet was not a clear gain by any means; and in fact it seemed doubtful if there was any gain whatever. It will be understood, as I have already intimated, that the saving is not in the increased yield of gas, but in the less amount of coal required to make the gas, which, in this case, is 100 pounds, and at $3 per ton, equals 15 cents. We will now inquire if this 15 cents per ton is really saved, or not. As an offset against it we have: First, a less amount of coke produced, equal to the weight of 500 feet of gas, say 17 pounds. The coke being worth $3 per ton, this 17 pounds is worth 2½ cents. Second, I found that the extra fuel required for a yield of 5 feet per pound amounted to 1 bushel of coke per ton of coal carbonized, or about 10 per cent., which amounts to 6 cents. Third, some time ago, in making a new contract for our tar, a buyer asked me if I carried high heats? I replied that I aimed to take out of the coal all of what I termed commercial gas; that my yield was about 13 gallons per ton. In that case, he said, I can afford to give you half a cent more per gallon than from the tar made from high heats, and he did so. I found when getting 5 feet to the pound, that the tar deteriorated both in quantity and quality, dropping from 13 gallons to 11½. I

am, therefore, I think justified in deducting from its value this half cent, which is equal to 6½ cents, and for the less quantity produced, 1½ gallons, which at 4 cents per gallon, equals 6 cents. I found no difference in the quantity or quality of the ammoniacal liquor; but the candle power dropped from 17 to 16¼ candles.

There is the weight here of 1½ gallons of tar amounting to 15 pounds, which I find some difficulty in accounting for, as the tar is supposed to be made in the hydraulic main. We must assume, I think, that with moderate heats certain heavy hydrocarbons find their way into the hydraulic main unimpaired; but with high heats these hydrocarbons are converted into free carbon, part of which adheres to the sides of the standpipes and the remainder is deposited in the hydraulic main. To sum up, then, we have as against the saving of 15 cents per ton of coal carbonized.

Less coke made	2½ cents
Increase in fuel	6 "
Less value of tar	6½ "
Less quantity of tar	6 "
	21 cents.

With modern regenerative furnaces the percentage of fuel will be, say 2 cents less than the figure I give, and there will be a saving in labor when making 5 feet to the pound, as there will be less coal to be handled aad fewer retorts in use. Perhaps this point will be more clearly shown if we should produce the cost sheet of the manufacturer of 1,000,000 cubic feet as follows:

Cost of carbonizing 105.26 tons of coal, making 9,500 cubic feet per ton: Coal costing $3 per ton; coke made, 1,240 pounds per ton, costing $3 per ton; 30 per cent. of coke used under the retorts; 13 gallons of tar per ton, at 4 cents:

Coal—105.26 tons	$315.78	31.6 cents per 1,000 cubic feet	
Labor	120.00	12.0 " " " " "	
Fuel—19.6 tons	58.80	5.9 " " " " "	
	$494.58	49.5 " " " " "	
Deduct residuals	191.82	19.2 " " " " "	
	$302.76	30.3 " " " " "	

Residuals.

Coke—45.7 tons at $3	$137.10
Tar—1,368 gallons at 4 cents	54.72
	$191.82

Cost of carbonizing 100 tons of coal, making 10,000 cubic feet per ton: Coal, costing $3 per ton, coke made 1,223 pounds per ton, costing $3 per ton; 40 per cent. of the coke used under the retorts; 11½ gallons of tar made per ton, at 3½ cents:

Coal—100 tons	$300.00	30.0	cents per 1,000 cubic feet
Labor	114.00	11.4	" " " " "
Fuel—24.46 tons	73.38	7.3	" " " " "
	$487.38	48.7	" " " " "
Deduct residuals	150.32	15.0	" " " " "
	$337.06	33.7	" " " " "

Residuals.

Coke—36.69 tons at $3	$110.07
Tar—1,150 gallons at 3½ cents	40.25
	$150.32

The result appears to be about the same as my former figures, and, if they are correct, would indicate that the maximum economical yield does not lie in the direction of high heats. There are certain disagreeable and expensive incidents invariably accompanied with the running of high heats. As I have already intimated, 15 pounds of tar per ton of coal carbonized are converted into free carbon. The carbon eventually chokes up the standpipes, and these stoppages generally occur when the make of gas is greatest, thereby causing a loss of gas, heat and time. The wear and tear of the benches is increased. The radiation of heat from the setting is also increased. In this connection I desire to call your attention to the valuable paper, read before the International Gas Congress, in Paris, by M. Euchene, on the "Thermic Reactions in the Distillation of Coal." Primarily, high heats are the cause of naphthalene stoppages in the works and street mains. I am aware that with moderate heats naphthalene can also be produced in mischievous quantities, but this is always caused by the subsequent maltreatment of the gas. In

increasing the yield from 4.75 to 5 feet per pound, the illuminating power is reduced about 1 candle, thereby necessitating the use of an extra amount of cannel or other enricher to bring the gas to the required candle power, the expense of which has to be charged to the extra gas made. In conclusion, it is well to remember that there is a maximum economical limit to the speed of a dynamo, railroad train and steamship, so there is also to the yield of gas from a ton of coal. I mention the truisms because I find it has become the fashion to speak of a ton of coal of 2,000 pounds yielding 10,000 cubic feet of gas, without any qualifications. Even some gas managers indulge in this exuberant sort of talk, thereby conveying a very erroneous impression of the cost of making gas to the minds of the municipalities and others with whom we have dealings.

DISCUSSION.

THE PRESIDENT—Gentlemen, Mr. Somerville's paper is a very interesting one, and I doubt not it will open up a good discussion. We would be pleased to hear from some of the members on the subject, especially from Mr. John McIlhenny.

MR. MCILHENNY—I have listened with great interest to Mr. Somerville's paper. I have knowledge of quite a large company that experimented for two years, the first year with high heats and the second with low ones. The first year it produced 5 feet and over per pound, from Penn, Westmoreland and West Virginia coals. The next year like coals were used, but the production was only from 4.70 to 4.75 per pound. Without going into the particulars of the case, the result was greatly to the advantage of the low heats. There was greater comfort in the retort house, less work in keeping up the heats in the second year; the material lasted longer—that is the retorts and brickwork showed less wear and tear. The best part of it all was, at the end of the year they had made more money than during the first year. I think that this is the best test we can give to any experiments.

THE PRESIDENT—Mr. Gimper may be able to add a fact to the discussion.

MR. GIMPER—I don't know that I can say very much on the subject, because we have been making water gas only for over a year; but I may speak of what I have done in the past. Mr. Somerville rightly says it is a question of locality. In our own

...feet to the pound if coal carbonized,
...candle gas. Still I have suc-
...candle gas. Our coal is very
...cheap. We have used Westmoreland
...West Virginia. We have full-depth regen-
...Beckel pattern, and I would like to know
...during Mr. Somerville used
...ten the natural draft.
...Mr. Somerville would find it difficult to
...that kind of bench. The difference of
...yield is not very much so that
...is with naphthalene as the other. As
...like experience with that recited by
...overcame the difficulty in this manner.
...inches and working 5-foot heats the
...asked. What is the matter with it? I
...it doesn't work like it used to."
...It would not run to our tar cis-
...trouble. So I separated the tar com-
...tanks above ground, from which
...easily be done. The tar coming from
...went into the oil wells. This worked
...was then glad to make a 5-year
...renewal again after expiration.
...half the tar was the light,
...He bought all the tar, heavy
...was used for making pitch for roofing

...like to ask Mr. Gimper if these re-
...temperatures?

...temperatures times in 24 hours,
...correct the yield to temperatures

...had some satisfactory exper-

...full depth benches and get a
...had an experience with our tar
...The man who was tak-
...what we were doing. We are letting
...and are getting the same price for it as

we did before, although there was some kicking. We get an average yield of a little more than 5 feet, and with our very low leakage account we sold 5 feet of gas for every pound of coal carbonized the past year. We have our naphthalene difficulties, but they are very easily overcome when you are fixed for them. With regard to candle power, we had only a jet photometer, which indicated about 17 candles. The washers and scrubbers we use retain the hydrocarbons instead of washing them out, and this we think accounts for the high candle power.

MR. HARTMAN—I am an advocate of high heats. All of the progress in carbonizing methods seems to point to higher temperatures. There may be at present attendant difficulties in the form of lampblack and naphthalene, but undoubtedly these difficulties will be overcome. Carbonizing at high temperatures with our present form of retort, we necessarily have an excessive amount of lampblack and naphthalene formed from the hydrocarbons in the gas, by the thermo-chemical reactions in the upper part, or fixing chamber of the retort. The lampblack mixing with tar stops standpipes and hydraulic mains, and the tar made is inferior in quality. The naphthalene is the source of trouble by stopping up apparatus or pipes either in the works or in the distribution system. In some plants, to avoid this trouble, one condenser or other piece of apparatus is maintained at such a temperature that the naphthalene will be condensed and deposited thicker in its upper part, or made of material less conductive of heat than in its lower part. Also, the use of hollow tile in bench arch construction to decrease radiation suggests making the upper part of the retort on the same plan. It seems reasonable to hope that by studying the thermo-chemical conditions in the retort, and altering them to meet the present requirements, we may carbonize coal at high temperatures and obtain a high yield of gas without a wasteful loss of hydrocarbons and without the attendant formation of naphthalene and lampblack therein. By cleaning out this piece of apparatus periodically and carting the naphthalene to the boiler room, they free themselves from trouble from this source in other parts of their system; but I believe that we do not realize what a wasteful process we are following when we allow valuable constituents of the gas to be converted into a substance so unstable that we must take it out of the gas with inconvenience and loss. In the retort we make a

gas rich in hydrocarbons, but before it leaves the retort it is subjected to chemical changes which entirely alter its composition. It is now low in hydrocarbons and high in the percentage of hydrogen, and some of the benzene has been converted into naphthalene, while the carbon liberated by the decomposition of the hydrocarbons is in part deposited on the walls of the retort, and in part travels with the gas and tar as an exceedingly objectionable constituent. In the water gas process, if we make naphthalene and lampblack, we know that our fixing chamber or superheater is too hot and we lower its temperature. In the coal gas process we make lampblack and naphthalene because the coal gas fixing chamber, or upper part of the retort, is too hot; but for relief we cannot lower this temperature without lowering the temperature of the lower or generating part of our retort. The objectionable feature of the coal gas process with the present form of retort is that the gas passing along the upper wall of the retort is heated as much as or more than the coal lying on the bottom of the retort. To remedy this condition it seems necessary to modify our retort. It may be that the upper part of the retort should be less conductive of heat than the lower part. We have learned that carbon deposits on the walls of the retort obstruct the passage of heat. Following this idea, perhaps our retort should be greatly modified in construction.

MR. RUNNER—We use no cannel coal at all. There is a tendency, of course, to stoppage of standpipes, but we have our men so well trained they give constant attention to this so we don't have stopped standpipes from one month's end to the other. Again, we sell our coke by measure and not by weight, consequently we are not in the same condition with those who sell by weight. We are not restricted to candle power by the city.

MR. MITCHELL—I will say I would stand for 5 feet per pound of coal. Our books show we make more money when we are making 5 feet than when we are making 4.70. We use for fuel slack coal which is not as costly as coke. We have, of course, trouble with stopped standpipes and bother in our hydraulic mains, but these difficulties can be overcome. We find there is more money in getting 5 feet than in getting a lower yield. Our retorts stand about 2 years and 3 months; sometimes 2 years and 6 months; 2 years and 6 months is very good life for a bench of retorts. With a yield of 5 feet we get a candle power of 16½,

and with the use of Welsbach lights and a little increased pressure on our mains, we get very good service.

Mr. Murdock, being called on by the President, said he didn't know that he could say very much on the subject. He was working under very poor conditions at the present time, but thought 4.75 to 5 feet was a very good yield. He would like to ask what run was followed by some of the members.

MR. CARROLL MILLER—Mr. President, referring to the figures that suggested 5 cubic feet yield, on top of page 45, the item of 12½ cents for coal I think should be stricken out. In my experience the difference as between 5 feet and 4.75, there is no less coke made, and this 500 feet of gas is more than accounted for in the tar which is decomposed. This tar Mr Somerville says is 15 pounds. Now, when this is decomposed the hydrogen is given out, and 500 feet of hydrogen weighs only 2.65 pounds. And this increase of fuel, while it will be the same per ton, I think will figure less per 1,000. With reference to the lower value of the tar, I don't think that, when you make your analysis of your tar you will find that the amount of free carbon will deteriorate half a cent; in fact, I don't think it will deteriorate at all, because if you use any process for flushing out your mains and removing free carbon before it can settle and make your tar thick, that tar is just as good as ever, whether your heats are high or low, because your tar deteriorates from the lampblack which separates from the gas on top of your main, and afterwards settles and mixes with the tar, thus making it thick. The high percentage of free carbon is lampblack. I have made up a rough balance from this, taking his figures for a yield of 5 cubic feet. I have 100 tons of coal $300, or 30 cents per 1,000; labor, $114. This is in the same proportion per ton as that which Mr. Somerville has. That makes 11.4 cents per 1,000, and fuel, instead of 24.46 tons, 19.67, which is in proportion to the yield of gas. As I said, I do not think that the fuel per 1,000 will be as much with 5 cubic feet yield as with 4.75; it will not be as much but I have taken it in proportion to the gas. That gives us 47.3 cents per 1,000. Then, credit by coke 43.4 tons at $3, gives $130.20, or 13 cents a 1,000, and tar 1,150 gallons at 4 cents—I don't think the tar will deteriorate—$46, or a total of cost of 29.7 cents. Then we have a reduction of ¾ of a candle. If we get 6 candles per gallon of oil, that will give us one-eighth gallon to

bring it up to the 17-candle power, which would give us 30.4 cents against his 30.3. Then, with full-depth benches we can probably, as Mr. Somerville says, save 2 cents on the fuel. That gives us 2 cents saving for a 5 cubic feet yield. I do not advocate the 5 cubic feet, in spite of this apparent 2 cents saving, because I think when you get up to too high heats, your stoppages and other troubles, lampblack and possibly naphthalene—this extra 2 cents will be more than or about taken up by the extra labor which you may have to spend for your stopped standpipes and naphthalene troubles, but still I think Mr. Somerville's balance is a little too much in favor of the 4.75 yield.

MR. FITZGERALD—Mr. Somerville states in his paper that when using high heats the cost of labor is reduced per 1,000 cubic feet. But my experience has been that the extra labor necessary for cleaning out stopped standpipes and heavy tar from the hydraulic main will more than balance any saving made in other directions, and the final cost of labor on high or low heats will be practically the same.

MR. FERRIER—I was about to make the point Mr. Miller made. I was going to ask Mr. Somerville if the decreased yield of coke was the result of actual experiment or merely surmise. In the paper of M. Euchene, to which Mr. Somerville refers, is given an account of some experiments in distilling the same coal at different heats. He found that the volatile matter coming off was about the same by weight in each case. By volatile matter I mean both gas and tar, so it would seem that the increased yield of gas is at the expense more of the tar than of the coke. But I will say that I think if the coke does not suffer in quantity it will in quality to some extent, and that it will be found in distilling at high heats there is a greater percentage of breeze and small coke than there is in distilling at low heats. I might say that Mr. Somerville's experiment with Pennsylvania coal I have tried with Alabama coal, and I find that in trying to get 5 feet or over to the pound there is the same trouble with lampblack, and when I came to look over the results I found that with stoppages involving waste of gas and time there was really a less yield per pound of coal and a less yield per man.

THE PRESIDENT—We would like to hear from someone else in this controversy.

MR. MITCHELL—Our President has had some experience in that line.

THE PRESIDENT—My inclination is for moderately low yield.

MR. BERKLEY—I would like to ask the gentlemen who advocate 5 pound yields if their results are based on long continued practice?

MR. RUNNER—I would say in all cases we refer to corrected temperature. I will say further, in regard to stopped standpipes and hydraulic mains, that I have seen works where they had to have three or four men on top of the benches at times, simply because they let the thing go until it is all blocked up, and they then have to take down the standpipes and have them opened up. We don't have a stopped standpipe once a month, simply because we look after them in a systematic way. We do not allow the standpipes to stop up.

MR. ELBERT—I have had a great deal of experience with regenerative furnaces, probably as much as anyone in this country, and I do not find all these bugaboos spoken about. We do not have any trouble with standpipes or hydraulic mains. I will say, though, we put a ⅜-inch steam pipe into the bottom of the hydraulic main, about two to a section; a short ⅜-inch nipple drawn down at one end to form a nozzle, and a thread at the other end with a ½-inch by ⅜-inch bushing made on. This nipple is bent at right angles and screwed into the bottom of the main, the nozzle headed towards the end of the main, where the tar is drawn off probably two or three times in 12 hours at the bottom and end of the main. We have two sections of main 36 feet long; that is, 3 benches. The other two sets are 2 benches long. This scheme will work up until you get 6 or 7 benches in a row. When drawing off the tar, turn on a little steam. It will take every particle of tar out, and you will not have any stopping of the hydraulic main. As far as the standpipes are concerned, it is simply the fault of the stokers. If you have your stokers trained properly (and with 7-inch standpipes which benches ought to have) you will not have any stopped pipes; if you do, it is all on account of the stokers. Of course, high heats will produce lampblack. The lampblack will mix with the tar which tends to stop up the pipes; but this can be taken care of. Last year (I made a memorandum before I left home), on fairly good Youghiogheny coal, our yields ran from 4.90 to 4.96 to the pound for the year. We made something like 34,469,000 feet to the bench of 9's, including carbonizing of the retorts, and some-

thing over 13 gallons of tar to the ton, and our bench fuel has always been below 20 per cent. of the coke. As far as I am concerned, I would not have anything but regenerative furnaces. We don't have any trouble with them.

THE PRESIDENT—That is about 30 per cent. of the coke made?

MR. ELBERT—No, sir; less than 20 per cent. of the coke made. Of course, I will say we figure our coke at 66 per cent. not including breeze. I think Mr. Somerville figures his at about 61 per cent., but that would only make a very small difference in his favor, yet our per cent. of bench fuel is very much less. I have known other houses that have equally as good results, if not better. They have tried a very high yield and a very low yield. I don't know what kind of a yield they are trying to get now. We aim to keep in the neighborhood of 4.90 to 5 feet. Our candle power is 16 to 17 right along. We are in a pretty cold country. We have a great range of temperature. The summer before last, during 2 or 3 weeks in July, the thermometer was 106°; and in the winter time we had 35° below zero. We get very cold winds on our benches and the retort house is narrow, but notwithstanding we manage to get along fairly well.

MR. DODDS—In 1897 I was engaged in a plant where we were unable, on account of the quality of the tile, to run high heats, in fact we had to run very low heats, so the yield was about 7,000 feet from coal which I knew contained a little over 10,000. The quality of the gas was interesting. The saturated hydrocarbon was a matter of 43 per cent., hydrogen was very low, the gravity was fairly high for the gas. The candle power for the whole run was about 18. Occasionally it ran to 20. The calorific value was as high as 775, and averaged around 725, if I remember rightly. There was an extreme case of low temperature. I ran the same kind of coal under other conditions and obtained a little over 10,000 feet. In the latter case the hydrogen was very high, the saturated hydrocarbons low and the gravity low. The candle power on the average, if I remember rightly, was very often 9 or 10 candles.

MR. SOMERVILLE—Of course, I knew very well I was treading on dangerous ground when I apparently advocated a moderate yield, but I simply tried to narrate the fact of the case. Mr. Ferrier knows very well that he cannot have his cake and

eat it also. The extra weight of the gas is at the expense of the coke, which I put at 17 pounds, or 2½ cents. Mr. Miller says he does not think the tar ought necessarily to deteriorate in quality, but the fact is it does, and the buyers are very quick to discover it. They say they can't afford to pay as much for tar containing only pitch. Mr. Fitzgerald raises a point which perhaps I ought to dwelt more upon; the extra labor entailed in cleaning out the standpipes. We all deplore the necessity of sending the men up to clean out the pipes especially in hot summer weather. Of course, certain precautions can be taken by boring out at every chance. Say the retort is open 5 or 10 minutes for this purpose. But look at the amount of heat dissipated; the open retort at a temperature of 1,800°, the atmosphere at 60°. The law of the equalization of temperature comes into play rapidly. Does not this operation require more fuel? Surely it does. I think, Mr. President, I have nothing more to say.

On motion of Mr. Gimper a vote of thanks was tendered to Mr. Somerville for his paper.

Upon motion the Association thereupon adjourned until 2 o'clock P. M.

FIRST DAY—AFTERNOON SESSION.

The President called the meeting to order pursuant to adjournment, and introduced Mr. John McIlhenny, of Philadelphia, who prefaced his paper on

GAS AND METERS,

by saying:

Mr. President and gentlemen of the Western Gas Association: The paper I have to read I would prefer to consider a "talk." It is not a technical paper in any sense. I think sometimes it is well that we pause to consider the source from which we sprang, the rock from which we were hewn. Consequently I have taken the liberty allowed an older man to be reminiscent, or to go back into the past a little.

When your worthy President, Mr. Barret, through the Secretary of this Association, did me the honor of asking me to write a paper for this meeting, I felt pleased, especially as the subject

[illegible]

[illegible] literally sit- [illegible] thinkers [illegible] over the [illegible] oil [illegible] the best [illegible] afford [illegible] the world! [illegible] the [illegible] part of coal, coal gas, or as the gas-lights say, the [illegible] sunlight of the ages in the shape of coal that was brought to illuminate the habitations of the dwellers in cities and towns and literally to lengthen their days.

[illegible] with the introduction of gas came a great mental awakening and desire by the advanced nations to educate the

masses of the people and to increase the comforts of living. Would it be a stretch of imagination or an unreasonable deduction to say that the dispelling of the gloom in city dwellings greatly enlarged people's usefulness, and largely increased the security of life and property, by lighting the streets that before this were the haunts at night of highway robbers? And I think all this did help to lift the mental cloud that has been lifting ever since.

Gas, like many other useful discoveries, was an evolution, progressing from one stage to another till to-day; and it is not done yet. Men will keep on making and selling it cheaper, and I have no doubt that many improvements are yet to be made in the manner of using it. Gas was known to the ancients, coming as it did from natural sources, or, as it was called, burning springs and wells. All works on gas lighting treat this more or less fully, but it has really nothing to do with the distillation of gas from coal and oil, or, as we call it, artificial gas. I like to think of good old Rev. John Clayton, Dean of Kildare, as the real inventor of the gas works. Some authorities dispute the claims that posterity makes for him, but all agree that his was the first real recorded experiment. One historian says that when Dr. Clayton was sitting by his sea coal fire, he doubtless saw bright shoots of flame with hissing noise or pressure rise from the lumps of burning coal. Then, as the story goes, he filled the bowl of his clay pipe with fine coal, put on the end or over the bowl a luting of clay, which was inserted in the fire, and the gas resulting was lit at the end of the stem. This was the first gas retort. He went on making it on a larger scale, collecting the gas in bladders; behold the first gasholder! This must have been sometime between 1730 and 1740, for, in 1739, he wrote to the Hon. Robert Boyle an account of his experiments, which Boyle afterwards, with his own comments, sent to the Royal Society of London, of which he was a member. This Robert Boyle—the great Robert, as he is called—was one of the most remarkable human beings and one of the finest characters in every way that ever lived, and a wonderful scientific genius. Boerehave says of him, "Mr. Boyle, the ornament of his age and country, had genius and talents of the highest order. We owe to him the secrets of fire, air, water, animals and plants." I introduce Dr. Clayton and Robert Boyle into this narrative to show you that

through their initiative minds the modern gas business has a very respectable parentage.

But little attention after this seems to have been given to the business until 1790, when Mr. William Murdock appears. He was familiar with the writings of Clayton and Boyle, and was a practical man, a great worker and a member of the Royal Society. He is unquestionably the father of the commercial gas business of to-day. Mr. Samuel Clegg invented purification by lime and the hydraulic main, the latter being the same as to-day, and was an immense step forward.

It was not till 1802 and 1803 that any real attempt was made to introduce the business to the public by Mr. Murdock. This was 100 years ago, and it has occurred to me that when so many events are having their centennial celebrations it might be well for the gas man to have one of his own to show the progress our business has made in that time. I will make this suggestion to the Western Gas Association, that you write all the Gas Associations of every name and kind to join us in one grand meeting in 1904, to be held in St. Louis. I think our Society is the one to take the lead in this matter, as the Louisiana Purchase and control of the Mississippi river were of far deeper concern to the Western States than to any other part of the country. Hence, I think it would be right and a graceful thing for the Western Gas Association to invite the other Associations of this country and our brethren from every land to join in celebrating our own centennial; 1904 will be just as appropriate as either 1902 or 1903, as all these years mark the beginning. I think it would be well if no other meetings were held in 1904, so as to conserve all our energy and means for the great event in St. Louis. I would suggest, too, that each Society deliver its annual address at this meeting, and in it give an historical account of the Association by the orator representing each, and when these addresses are preserved in book form they will be very valuable records.

While Mr. Murdock and Mr. Winsor were working manfully to introduce and establish the business, they met with very poor success. At that time men's minds were not receptive for new things. On the contrary, innovations were ridiculed and resented, and gas had a peculiarly hard road to travel, as the people and the lawmakers professed to believe that it was a very dangerous

element, and sooner or later would blow up the towns and places and kill everybody where it was introduced.

An event happened in 1814 that gave gas a great boom. This year the allied powers met in London to celebrate the overthrow of Napoleon, and all writers on the subject speak with enthusiasm of the new light, seen for the first time, no doubt, by most of the thousands who gathered in and around St. James Park, where a pagoda was erected in which there were 10,000 gas lights, which, by some contrivance, were all lighted at once. After this the attitude of the public and the newspapers changed at once, and the latter were unstinted in their praise of the gas light. They said its brightness was as clear as the summer noon, but soft and beautiful, and, among the many things said besides, was that the beauty and loveliness of women were greatly enhanced by the soft but brilliant rays. The large retinues of men and women who accompanied the representatives of the allies carried back with them to their own countries the accounts of the wonderful illumination by the new light, and to a considerable extent gave it a better position in the public confidence than it ever had before. Still, there was something wanting—a measure to measure the gas to the consumer was needed, as everyone then in the business saw and felt. The meter had not come, and charging so much by the hour per burner would not do. Disappointment, bankruptcy and exceedingly high prices was the rule before the advent of the meter. The invention of the meter saved the gas companies. I quote from Mr. Richards the following:

"The whole history of the gas meter is one of great philosophical interest. * * * The system of charging the consumer an annual rent for a certain number of burners, on the supposition that these consumed a given quantity of gas per hour, was found to be exceedingly vague and unsatisfactory. It obviously afforded the means of so much fraud that gas companies were necessarily obliged to leave an ample margin to cover the contingencies of dishonest burning."

This was the only way known in the early days of our business, whereby a bill could be made against a consumer, and every man in this convention knows very well that his business could not be carried on under any such system. You know, too, that gas could never have been sold as cheaply as it is unless every

consumer pays for exactly what it consumed. Mr. King says: The gas meter has been of incalculable service to the gas business. Gas was an evolution, the meter was not. It was invented to fill a definite place and the meters in use to-day—viz., the Crossley wet meter and the Glover dry meter, are the same [illegible] as first produced, some slight changes in construction only having been made but the basic principles are the same, and wherever a country where gas is known the same meter is used.

I have often wondered why it is that an instrument which has such a good character among scientific men and those who understand it should have so much abuse heaped on it by some gas consumers and reckless newspaper scribes. The latest slander I have heard was a suit brought by a New York company to recover a bill. The lawyer for the defendant asked the representative of the gas company what evidence he had that the man owed the bill. The gas man said the meter. "The meter! the meter!! the meter! I wouldn't believe it on its oath." There are lots of smart Alecks like this one but for all that the meter has won its way in every court at law, when gas companies have gone before such tribunals to collect bills. The famous case of the London Gas and Coke Company vs. the Northwestern Railway Company and the equally famous case in this country of the Louisville Gas Company vs. Macauley's Theater, were both long trials the best scientific talent being employed, and the meter won triumphantly by the admission of both sides.

One of the defects of the gas business is that it is and always has been a purely credit one, neither the seller nor the buyer knowing until the state of the meter is taken, what the bill will be, and it is only reasonable that disappointment and objections result.

I once asked a railroad man, who was complaining bitterly of gas bills how he would get along if he had to collect the fares at the end of the journey from the passengers who would not know how many miles they had traveled. "Why," said he, "we would have a riot at the end of each trip." Instead of that they have the prepayment system, everybody paying in advance, and the peace and comfort of the journey are not disturbed by disputes at the end. So it is with the gas consumer who has a prepayment meter. He puts a quarter in the slot and he and his good wife are astonished at how long a quarter's worth lasts, and their

journey through life is made happier because the head of the house is not making life to her a burden by complaints about the size of the gas bill. I have been told by more than one gas superintendent that the complaints about bills are much fewer since the introduction of the prepayment meter, because, I suppose, of the operation on the mind when people are compelled to accept one thing, but when they have the choice of two they feel better.

I will say here what I have often said before, that gas is the cheapest thing brought into a house for use. My belief in this was greatly strengthened by having the opportunity to investigate a general charge of excessive bills collected by a gas company. The company in question had, in round numbers, 26,000 consumers, 6,000 were counted off as large customers. It was found that 20,000 had bills that averaged a little less than $2.50 a month, or a fraction more than 8 cents a day. A majority of the 20,000 had average bills of $1.50 a month, at a cost of only 5 cents a day. Now, what else could a family buy for 5 cents which would be as useful and give as much comfort as the 5 cents worth of gas? We would not consider it an extravagance for any member of the family to spend 5 cents for a car fare, or for the head of the house to buy a 5-cent cigar. These are individual expenses, enjoyed by only one, while the 5 cents worth of gas is enjoyed by the entire household.

In this historical sketch of our business I have only dealt with the initiative men, all of whom deserve our highest esteem and gratitude, and they have been benefactors to a very large part of mankind. I have not mentioned the history of gas in this country, as that would make this paper too long, but will only say now that the first gas works built in America for public use was in Baltimore, in 1817, and the first meters made in America were made in Baltimore also.

In the entire history of the gas business there have been really only two ways or systems for producing it, namely, in externally heated chambers or internally heated chambers. Gas from coal, oil, rosin, wood, peat, etc., have been made in externally heated vessels, and, as far back as 1825, water gas was attempted in heated pipes. To Mr. Thaddeus S. C. Lowe, now of California, we owe the great invention of water and oil gas produced in internally heated chambers, properly known as the Lowe process, which has been of immense advantage to the gas interests of this

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ture of an established profession [illegible] and strong the foundations upon which we are to-day erecting the safe structure of an unexampled prosperity. Too much credit cannot well be given to these early founders of a giant industry that has so greatly added to the broadening of civilization and the comfort and happiness of mankind. I quite agree with the writer of this paper that it is exceedingly desirable that our literature should be enriched with a history of the rise and progress of the gas industry in the United States, and I sincerely trust that such a

work will yet be forthcoming. It is well for us of the later generations of gas men, to know that we are worthy scions of the men who, coming from the training schools of the old-time shop and foundry, from commercial life, together with a few men of high scientific attainments, crossed boldly into an unknown, undeveloped industrial field, daring its risks, blazing their way as they went, teaching themselves and the public, and finally handed down to their immediate successors an established business that their efforts had raised to the dignity of an acknowledged place in the world's necessary professions. It is with hearty pleasure that I move a vote of thanks of the Association to Mr. McIlhenny.

The motion was seconded and carried.

MR. GIMPER—A thought in this paper has not been touched upon, and I wonder whether the Association had not better act on it. It is where Mr. McIlhenny says he thinks it would be proper for the Western Gas Association to invite the other Associations of the country to join in a celebration of our Centennial.

THE PRESIDENT—I think, perhaps, a motion referring so much of that as pertains to the place of meeting to the Committee on Place of Meeting for the next year would be proper and might be productive of good, but the selection of the place is in the hands of that Committee. It might influence the Committee. I would be glad to entertain a motion to such effect.

MR. HOWARD—I think it should be referred to the Committee on Next Place of Meeting. The discussion, of course, amongst the Committee would be with a larger attendance for discussion than if committed to the care of the Board of Directors. I move to refer the matter to the Committee on Place of Next Meeting. [Adopted.]

ELECTION OF OFFICERS.

THE PRESIDENT—We are about through with the ordinary schedule for the afternoon session. It has been suggested that we proceed to the election of officers in order to do away with a night session. If there is no objection we will take that course. [So ordered.]

The President called for nominations for the office of President

for the ensuing year. The only nomination being that of Mr. F. H. Shelton, of Philadelphia, Pa., on motion the Secretary was instructed to cast the ballot of the Association for Mr. Shelton, which was accordingly done, and Mr. Shelton was declared elected President for the ensuing year.

THE PRESIDENT—Mr. Shelton, it affords me a great deal of pleasure to announce to you that you have been elected President for the ensuing year.

Mr. Shelton being called on for a speech, responded as follows: It is not giving the retiring President half as much pleasure as it gives me, I am sure! I feel very much gratified at the courtesy you have shown me and particularly because I am not in the territory chiefly covered by the Western Association. As an Eastern resident, and most of my business in the East, I think it is a great compliment to be asked to preside for a year over your deliberations, and I feel, too, that as one of the younger men of the Association it is a compliment to be put above older men even for a short time, and I certainly shall do my uttermost to "make good," as the expression is. I have tried to be a worker in the time past—I think with some fair measure of success—to advance the work of the Association, and I look upon the position of President as simply a greater opportunity for advancing the Association's work. It has its responsibilities as well as its pleasures, and while I am enjoying the compliment (I am frank to say I do enjoy it; it is a thing we all appreciate under such circumstances), I none the less feel that the greater thought is how to use the opportunity that is given to advance the interests of the Association. The condition is peculiar this coming year. By virtue of the action of the Council yesterday—exercising a mean advantage when I was away, not present to protect my interest—and when I arrived in the afternoon, I was told the Council had resolved not to have any Executive Committee in future, but to place the control of Association work in the hands of the President. I have not figured out whether they felt with due humility that with me as President they could not comparably associate, the Executive Committee being so completely outclassed, or whether they felt it the other way; that they did not propose to "stand for" *me*, consequently they would all get out! At any rate I will be left to run things alone. In all my experience in gas companies I have found the manager or

superintendent who is not interfered with by a Board of Directors is always happiest and perhaps in many ways most successful in his work, and it certainly seems as though I would occupy such a position this year. Even our retiring President, Mr. Barret, has established, with great courtesy, a new precedent to lessen my work, by his courage in omitting the traditional presidential address. He foresaw that it would be difficult for me under the conditions at St. Louis where there is quite a likelihood the meeting will be held, to hold any respectable crowd together, and did that now which might make it easier for me to curtail my work. However, I will not make any promises as to presidential address or other features, but seriously speaking, I will simply try to "make good" next year, in 1904. I thank you. (Applause.)

Mr. O. O. Thwing, of St. Louis, Mo., having been nominated for First Vice-President, on motion the Secretary was instructed to cast the ballot for his election. The Secretary reported that he had followed the instruction, and the President informed Mr. Thwing of his election.

In response to calls for Mr. Thwing that gentleman said: I will only say I thank you sincerely for this expression of your good feeling towards me. (Applause.)

The President announced that the next order was the election of Second Vice-President. Mr. Paul Doty, of Detroit, Mich., and Mr. K. M. Mitchell, of St. Joseph, Mo., were nominated. Upon a ballot being taken the tellers announced 28 votes for Mr. Doty, and 21 for Mr. Mitchell. Voting 49. Mr. Doty was thereupon declared elected to the office of Second Vice-President. Responding to the announcement Mr. Doty said:

Gentlemen of the Western Association: I desire to assure you of the extreme pleasure and gratification that I feel over this mark of your confidence in me. I feel somewhat that I can steal the thunder of Mr. Shelton, in saying that I was an Eastern man. I am not one now. I am a Western man. I am part of it, my sympathies, my hopes, my ambitions are all in the West; this Middle West that is represented here so strongly in this Western Gas Association. In a gathering of this kind, my associates, members, fellow workers, it cannot help but stir the heart of any man, and make him feel he is a better man by having been singled out for such a mark of distinction.

The President announced that next in order was the election of Secretary and Treasurer.

On motion of Mr. William McDonald, the President was directed to cast one ballot for Mr. James W. Dunbar as Secretary and Treasurer of the Association. The motion was seconded, put to a vote and declared unanimously carried. The President announced the result, and in response to calls Mr. Dunbar spoke as follows: Gentlemen, I accept with pleasure the result of your decision as to who shall serve you as Secretary during the coming year. One of the greatest pleasures of my life is to serve you as Secretary and the reason is that by so doing I am able to come in contact and intimate association with some of the best fellows on earth. (Applause.) I assure you that there is no companionship or friendship that I appreciate more than those I have enjoyed and come into by reason of being a member of this Association. (Applause.)

Mr. W. E. Steinwedell, of Cleveland, O., was placed in nomination for the Editorship of the Wrinkle Department. On motion, the Secretary was directed to cast one ballot for the election of Mr. Steinwedell, which was done, and Mr. Steinwedell was declared duly elected.

In response to calls, Mr. Steinwedell said: I can only say I will do the very best I can, with the understanding that Mr. Miller run for the position next year, in accordance with his promise.

The election for Directors resulted as follows:

To serve two years—Messrs. K. M. Mitchell, St. Joseph, Mo.; Wm. McDonald, Albany, N. Y.; Thomas D. Miller, New Orleans, La., and John D. McIlhenny, Norristown, Pa.

To serve one year—Mr. D. R. Warmington, Cleveland, O.

The Association thereupon adjourned, to convene the following day at 10 A. M.

SECOND DAY—MORNING SESSION.

The Association was called to order at 10 A. M. of the second day. The first business was the consideration of the report of the Committee on Applications for Membership, who recommended the following gentlemen for election:

Active.

Blauvelt, W. S., Detroit, Mich.
Crowley, J. P., St. Paul, Minn.
Carson, G. S., Iowa City, Ia.
Dougherty, D. J., Jacksonville, Fla.
Forbes, C., London, Ont.
Fitzgerald, B., Cleveland, O.
Gimper, E. H., Galveston, Tex.
Griffin, T. M., Muncie, Ind.
Geist, C. H., Chicago, Ill.
Haines, J., Des Moines, Ia.
Hartman, W. E., Norfolk, Va.
Lyman, L. G., Pueblo, Col.
Murphy, C. A., Ottawa, Ill.
Morton, H. E., Boone, Ia.
Mockett, W. E., Dallas, Tex.
Marshall, W. D., New Orleans, La.
Miller, C., Chicago, Ill.
Meaker, C. A., Muncie, Ind.
Moreland, M. A., Chicago, Ill.
Purcell, T. D., Chicago, Ill.
Pearson, J. R., Indianapolis, Ind.
Reitmeyer, A. F., Perth Amboy, N. J.
Springer, E. S., Leavenworth, Kan.
Spinning, W. V., Peru, Ind.
Strolin, R., La Grange, Ill.
Vollum, W. H., New Orleans, La.
Walsh, J. T., Chicago, Ill.

Associate.

Brownell, E. E., Dayton, O.
Dresser, S. R., Bradford, Pa.
Gilman, G. P., Jr., Chicago, Ill.
Kellum, B. J., Chicago, Ill.
Lea, H. I., Fort Wayne, Ind.
Parker, R. H., Chicago, Ill.
Pattum, W. H., Chicago, Ill.
Patterson, M., Cleveland, O.
Plantinga, P., Cleveland, O.
Schall, H. B., Chicago, Ill.
Shirra, J. C., Milwaukee, Wis.

ELECTION OF NEW MEMBERS.

On motion of Mr. J. B. Howard, Mr. Wm. McDonald was authorized to cast the vote of the Association in favor of the applicants named.

The President welcomed the new members and expressed the hope that they would freely take part in the proceedings.

ROLL CALL.

Roll call disclosed the presence of the following:

Honorary Members.

Harbison, J. P., Hartford, Conn.
White, W. H., New York City.
Howard, J. B., Galena, Ill.

Active Members.

Atkinson, G. G., Goshen, Ind.
Barret, A. H., Louisville, Ky.
Barron, A. M., South Bend, Ind.
Berkley, J. M., Mobile, Ala.
Blinks, W. M., Michigan City, Ind.
Bowers, W. L., Davenport, Ia.
Bredel, F., Milwaukee, Wis.
Buck, E. H., Vincennes, Ind.
Butterworth, I., Denver, Col.
Clapp, G. N., Middletown, O.
Collins, C., Elkhart, Ind.
Cooke, A. S., New York City.
Copley, I. C., Aurora, Ill.
Cowdery, E. G., St. Louis, Mo.
Cowdery, R. E., Topeka, Kan.
Cressler, A. D., Fort Wayne, Ind.
Diall, M. N., Terre Haute, Ind.
Dickey, C. H., Baltimore, Md.
Doty, P., Detroit, Mich.
Doherty, H. L., New York City.
Dunbar, J. W., New Albany, Ind.
Elbert, V. L., St. Paul, Minn.
Elston, I. C., Jr., Keokuk, Ia.
Enright, J. H., Carthage, Mo.
Ferrier, J., Columbus, Ga.
Fitzgerald, J. H., Houston, Tex.
Forbes, J., Chattanooga, Tenn.
Forstall, A. E., New York City.
Freese, F. W., Fort Wayne, Ind.
Fullerton, G., Jr., Buffalo, N. Y.
Gerould, C. L., Galesburg, Ill.
Gimper, J., Galveston, Tex.
Goodnow G. F., Waukegan, Ill.
Haase, E., **Milwaukee, Wis.**
Harper, G. H., **Altoona, Pa.**
Howard, C. A., **Aberdeen, S. Dak.**
Hyde, H. H., **Racine, Wis.**
Jones, T. C., **Delaware, O.**
Keller, C. M., **Columbus, Ind.**
Kelley, F. W., **Davenport, Ia.**
Knight, C. S., **Fort Wayne, Ind.**
Landon, H. McK., **Indianapolis, Ind.**
Leonard, W. H., **Chicago, Ill.**
Lloyd, E. F., **Detroit, Mich.**
Luther, F. E., **Chicago, Ill.**
Lynn, J. R., **Waterloo, Ia.**
Lynn, J. T., **New York City.**
Mansur, J. H., **Royersford, Pa.**
McDonald, D., **Louisville, Ky.**
McDonald, W., **Albany, N. Y.**
McIlhenny, J. D., **Philadelphia, Pa.**
McKee, J. M., **Meridian, Miss.**
Miller, T. D., **New Orleans, La.**
Miller, A. S., **Baltimore, Md.**
Miller, I. A., **Colorado Springs, Colo.**
Mitchell, K. M., **St. Joseph, Mo.**
Morrell, E. E., **Oak Park, Ill.**
Moses, F. D., **Trenton, N. J.**
Murdock, G. T., **Elkhart, Ind.**
Murdock, J. W., **Joliet, Ill.**
Norris, R., **Philadelphia, Pa.**
Nutting, C. H., **Chicopee, Mass.**
Olds, H. L., **Bloomington, O.**
O'Malley, P., **Aurora, Ill.**
Page, C. H., Jr., **Philadelphia, Pa.**
Perkins, B. W., **South Bend, Ind.**

Pratt, E. G., Milwaukee, Wis.
Quinn, A. K., Newport, R. I.
Roper, G. D., Rockport, Ill.
Runner, Z. T. F., Freeport, Ill.
Salter, W. J., Florence, Ala.
Searle, R. M., Mount Vernon, N. Y.
Shelton, F. H., Philadelphia, Pa.
Slade, R. E., Lockport, N. Y.
Somerville, J., Indianapolis, Ind.
Steinwedell, W., Quincy, Ill.
Steinwedell, W. E., Cleveland, O.
Stephens, A. K., Washington, D. C.
Sweetman, M. M., Kansas City, Mo.
Thwing, O. O., St. Louis, Mo.
Wallace, W., Lafayette, Ind.
Walker, E. M., Hyde Park, Mass.
Walker, S. R., Bay City, Mich.
Waring, G. H., Omaha, Neb.
Warmington, D. R., Cleveland, O.
Warmington, G. H., Cleveland, O.
Whysall, G., Evansville, Ind.
Witherby, E. E., New York City.

Associate Members.

Barnes, G. W., Pittsburg, Pa.
Buckley, J. C., Chicago, Ill.
Carpenter, H. A., Pittsburg, Pa.
Claybourne, C. W., Chicago, Ill.
Corbus, F. G., Cleveland, O.
Eaton, A. B., Chicago, Ill.
Elliott, H. J., Chicago, Ill.
Gassett, A. L., Detroit, Mich.
Guldlin, O. N., Fort Wayne, Ind.
Harper, H. D., Chicago, Ill.
Hayward, S. F., New York City.
Helme, W. E., Philadelphia, Pa.
Jacobs, C. H., Detroit, Mich.
Johnston, E. D., Connersville, Ind.
Lindsay, C. R., Chicago, Ill.
Martin, J. H., Chicago, Ill.
McDonald, D., Albany, N. Y.
McIlhenny, J., Philadelphia, Pa.
Osius, G., Detroit, Mich.
Parker, G. W., St. Louis, Mo.
Persons, F. R., Toledo, O.
Russell, D. R., St. Louis, Mo.
Stacey, A. J., Cincinnati, O.
Steward, R. B., Chattanooga, Tenn.
Terhune, C. F., New York City.
Wickham, L., St. Louis, Mo.
Witherden, G. M., Philadelphia, Pa.

REPORT OF COMMITTEE ON NEXT PLACE OF MEETING.

On call from the President the Committee on Place of Next Meeting, through Mr. F. H. Shelton, submitted the following report:

It seems the prevailing idea of the membership of this convention to hold its next meeting, in 1904, in the city of St. Louis, in view of the Exposition feature that will there exist, and to which many of the members will probably desire to go in any event. In accordance with that feeling the Committee decided to recommend St. Louis as the place of meeting. At the same time this report of the Committee to that effect can be accepted or rejected by the members, of course, at their pleasure. I might say the sentiment seemed to be so general for St. Louis that no other place was either mentioned or suggested. The Committee felt that the selection was not entirely ideal. It is hard to have anything but hurried sessions and irregular attendance in Exposition years, but there seemed to be no nearby town in which we could meet and then adjourn to St. Louis without going a considerable distance. The Committee finally concluded that St. Louis would be the place after all, and it so reports.

On motion of Mr. William McDonald, the report of the Committee was received and adopted.

REPORT OF COMMITTEE ON PUBLICATION OF PROCEEDINGS.

Mr. O. O. Thwing, of St. Louis, read the following report from the Committee on Publication of Proceedings:

To the President and Members of the Western Gas Association:

Your Committee regrets to report that it has been impossible to issue a volume of the "Proceedings" during the past year.

The next volume will include the Proceedings of the years 1899, 1900, 1901 and 1902. This volume is in preparation and will be published during the coming year.

O. O. THWING, Chairman,
ALTEN S. MILLER,
WM. MCDONALD,
Committee.

On motion of Mr. Miller the report was accepted and the Committee continued.

REPORT OF LIBRARY COMMITTEE.

Mr. F. H. Shelton, from the Committee on Library, presented the following report:

To the Members of the Western Gas Association:

You will remember that two years ago the George T. Thompson library was bequeathed to this Association, and that its custody, and the best way to make it of use to the members, was left in the hands of this Library Committee, then created for that purpose, and that about the same time I recommended the making in particular of a card index for references to gas books and articles, and that this work was authorized and left in the hands of the Library Committee.

Referring, first, to the library, the Committee has been disappointed in its small use by the members, and is somewhat at a loss to account for it. During the year scarcely half a dozen books have been called for. The number of books is over 200, and they cover a wide range of subjects directly pertaining to our daily business. It would seem as though they should be used to a greater extent than has been the fact. The Committee, surmising that possibly the rules may not be practical, or in some way objectionable, or that the library has not been sufficiently advertised, will greatly appreciate it if any of the members with ideas or feeling on the subject will kindly point out any weaknesses, in the discussion of this report. It is felt, in part, that the greater publicity, to make the library better known, might be well for the present at least, and that possibly the information regarding it (in the back of the printed list of members) is rather obscure, so it is recommended that, until further notice, the list of books, rules and information concerning it be printed and mailed separately and in large type and form, and that a brief quarterly bulletin be printed and mailed each member, advising and reminding of the library, and of additions to it.

The thanks of the Association are extended by the Committee to those who have donated books during the year: Messrs. J. B. Howard, Wm. McDonald, Albert Dunbar, Jas. W. Dunbar, A. H. Barret, Holyoke (Mass.) Gas Co., and F. H. Shelton.

It is needless to say that further contributions are earnestly requested. Only by the members helping can the library be built up into the comprehensive, complete and helpful feature that it ought to be of our Association work.

As to the "Card Index." You will recollect that this was extensively advertised and broached, and that it was started as a subscription undertaking, costing each member from $10 to $50

a year, somewhat according to the size or nature of the company. A good number of subscribers was secured, but the first year went by without progress in the work, owing to not being able for a variety of reasons, to secure a suitable man to do the work of indexing. Half a dozen men were considered, but could not undertake the work for one reason or another. In order to avoid further delay, I decided thereupon to do what I could, and to start the work myself; and I personally, this past year, have prepared that which the Committee now returns as its first delivery or part of the work.

I take pleasure in submitting herewith a card index of some 1,340 references to books and articles on gas subjects. It is the key to almost anything in gas that one wants to know. That is, it directly tells one where one can find the latest articles on any subject, or what books there are. For instance—at random—one is looking up tar pavements. There are references to 6 recent articles on that subject. One is interested in coke ovens. There are references to about 25 different articles on the subject. One wants to look up inclined retorts. There are about 25 articles also, etc., etc. The references are in printed card form packed in cardboard boxes about 4x5x18 each, and are classified into 77 different subjects, from coal bins, concrete specifications, underwater mains, or anything else in the practical line, to the driest articles on taxation, depreciation, municipal control and other controversial topics.

This index includes every paper that has been presented to the New England, the American, and the Western Associations, from the beginning of each. It includes every book (some 200), that I could get track of, as ever published, pertaining to the gas business; and it includes every paper of the Ohio, the Michigan, the Pacific, and the Texas Southwest Associations, of the last five years, and every other article that seemed practically worth while, that has appeared in the American Gas Light Journal for the past five years—that is, from 1898 to 1902 inclusive—and this includes many English papers reprinted. The index in brief covers practically all current references and the best current thoughts on gas topics.

Do not think, however, that because it exists, your condition will automatically improve. It is not worth 10 cents unless it is intelligently used. Books unopened teach nothing. Books themselves

are worthless to the sluggish, or to those who do not seek in their pages, or do not try to read them. But to the earnest worker, to the man who wants to know more about some certain topic, this index will, in my opinion, tremendously help.

As to the continuance of the work: What is in hand is good, but it can be enlarged by indexing papers and articles in the last 10 to 15 years, many of which are standard and most helpful, and it should be kept up. The Committee recommends that the Committee be continued, that the Association allotment of $250 be renewed, that the best arrangements possible be made by the Committee for the indexing of this year's articles and as much of previous years as feasible.

Finally, to those who use the index, these points: It is not supposed to cover presidential addresses, experience and advertising departments or wrinkles, which it is hoped to sometimes have collected and separately published, natural gas, acetylene, legal decisions of local interest only, patent processes not tried out, and general subjects, such as heat, coal, steam, etc. It aims to be a practical gas man's index to recognized gas subjects. If one has a file of the Journal an article can be read at once. If not, go to the nearest company that has a file and read up, and to those of you who may contemplate getting any of the books referred to (if they are not in the Association Library to be borrowed), I shall be more than glad to reply to any inquiries as to character, size, price, where they can be procured, etc.

Respectfully,

F. H. SHELTON, Chairman,
WM. MCDONALD,
O. O. THWING,
A. H. BARRET,
JAS. W. DUNBAR,
Committee.

At the close of the report Mr. Shelton further said: In regard to this index I would like to give you an idea of its completeness. It is printed in three colors. White cards are references to articles in journals and gas papers. Pink cards are references to books on the subject. Yellow cards are the tab guide or subject cards.

MR. MCDONALD—You have not stated how it is to be obtained.

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The Treasurer introduced Mr. [illegible] of South Bend, but [illegible] who is of the following opinion:

DEVELOPING A SUPPLY OF GAS TO EXISTING CONSUMERS

How shall we increase the value of gas to existing gas consumers? It can be answered by saying, "Get out and hustle," but the hustling can be very materially aided by conditions that can be

brought about by the efforts of the people in charge, viz: A feeling of confidence between consumers and the gas company, good advertising, the good will and opinion of the press and the same of the city government.

I would not attempt to lay down an absolute plan. I will make a few suggestions with the hope that they, with any discussions that may follow, will fully answer the question.

Without a feeling of confidence between the consumer and company it is well nigh impossible to get a consumption beyond what one might think is absolutely necessary. On the other hand, if the consumer has implicit confidence in the company with which he is dealing, it is much easier to present a convincing argument as to the merits of appliances which you may seek to sell. The ways to establish this confidence have been dwelt upon by writers of other papers, and consist mainly in not permitting any dissatisfaction to exist. If the consumer has a large bill there must be some reason for it. The size of it was not made by the company but by the consumer himself, and it should be the company's business to ascertain the cause. In many cases it may be very easily determined by the use of a complaint meter. It is not always possible to make an exact explanation of large bills, but it can be done in a majority of cases. For instance, people using stoves will not be as careful in lighting and extinguishing them in winter as in summer, as heat in cold weather is as desirable as it is undesirable in summer, and their personal comfort is a greater incentive to economy in hot weather than in cold weather. Their needs, so far as cooking is concerned, are no greater one month than another; but cold weather will show larger bills for cooking than summer, and without an explanation the consumer will naturally think he is getting the worst of it. If meter inspectors make an error in taking the meter statement, the right thing to do is to acknowledge it and correct the mistake at the time, or the following month, as the consumer might prefer. We are all mortal and prone to err, and the consumer will think much more of you, if the mistake has been made, to acknowledge it, rather than to make him believe that he has burned the gas.

With a feeling of confidence between consumer and company it is possible to get the consumer to use gas for everything that requires heat and light, with the possible exception of continuous

heating, as is proved by different people on the same street using gas for so many different purposes.

For instance, Smith uses gas for cooking, Brown uses it for lighting and uses coal for cooking, Jones uses gas only for a couple of grates, lights his house with electric lights, and has his cooking done with gasoline and coal. Now, if they each find it economical to use for their different purposes, it would seem that each, with proper arguments, could be induced to use it for all purposes mentioned.

The service pipe and meter are originally put in for light or fuel, and sometimes for both. If for one purpose only, the consumer repeatedly visited by a solicitor, and on his failure, another can generally get the fuel consumer to put in lights; if not the whole house, get one light, and later the whole place can be secured. He must constantly keep the fact before the people that gas is the best and cheapest light per candle on earth. It is the most reliable. It can be turned up or down, and the requirements large or small constantly met. It never goes out. In short, it is the best light that money can buy.

If the consumer uses gas for light, he uses the same arguments as to gas for fuel. These facts should be impressed on your solicitor so thoroughly that he will be an enthusiastic believer himself, as no one can tell the merits of gas as well as those who believe in it themselves. If the consumer uses gas for both illuminating and cooking, sell him a water heater, either circulating or instantaneous, a gas grate or log for his fireplace, a heating stove for an occasional cold day, spring or fall, also a small heater for his bathroom at any time, a boiling stove for heating small quantities of water elsewhere than the kitchen, etc., etc.

If coal stoves are used for heating, sell them a Bunsen tube to light their fires with. This will do it right and not smut the mica. Gas ranges can be used in churches, lodge rooms and society halls, and no trouble will be experienced in starting their sale if there is the slightest need for them, or if the arguments are brought forcibly to them.

Scarcely a place can be found that could not find some use for gas. People as a rule do not know how many useful purposes to which gas can be put. Among them might be mentioned: Cooking, heating, laundry work, water heating, both circulating and instantaneous, distilling water, lighting coal fires, brazing,

heating Japanning ovens, tempering steel, brazing paint burning, heating moulding machines, ripening bananas, general dental uses, coffee roasting, peanut roasting, heating candy to soften it, wood embossing machines, heating glue pots, heating cylinder for bending veneer, heating wax for harness sewing machines, heating card embossing machines, heating copper half-tone plates, soldering iron furnaces, re-curing tobacco in cigar factories, bookbinders, shoemakers, jewelers, water bath for keeping things warm, heating ventilating flues, china kilns, heating small steam boilers, meat broiling in refitted charcoal broilers, gas engines, enameling ovens, etc., etc.

Gas arc lights, if rented by the gas company, will prove one of the best increasers of consumption, as well as a profitable investment from which to derive an income for rental. Likewise, appliances, stoves, etc., sold at prices and installments that people can pay.

Personal visits of the manager or some other competent person to factories, etc., will be productive of good results, as he will notice places where gas can be used with profit to the owners and the gas company. For example, the writer was in a paper box factory recently on some business other than gas, and on going through one of the rooms noticed that the folding machines used steam heated glue pots. It only took about five minutes to show the owners that a circulating water heater could do the work better and cheaper in summer than they could keep a steam boiler fired up. Numerous other jobs have been secured in this way.

To systematically work the territory a card index should be kept and corrected at intervals, of every house along the lines of mains showing what each used for lights, fuel, etc. From this can be kept small books with the information tabulated under the street numbers for the use of the solicitor. These will enable the solicitor to put his time where it will do most good.

He can make his visits for a distinct purpose, and not annoy people by useless questions, or trying to sell them something they already have. Among the best advertisements a company can have are people who are using gas appliances they are satisfied with. If the housekeeper has an appliance in her kitchen that lightens her work and raises the standard of her cooking, she is sure to tell others. So if she is satisfied with some gas

appliance that she may be using, she will be the means of making the path easy for the solicitor among those not supplied, when he makes his visits. Good newspaper advertising is very essential and necessary, as it brings you in contact with people you would not reach by any other means. If the gas "ad." appears in the paper every day, and in places where the reader cannot help but see it, it will in time bring many a customer that would not be interested otherwise. Newspaper advertising cannot be too highly recommended.

There is a good deal of advertising that can be done outside of newspapers. Bulletin boards can be utilized, posters can be used, attractive printed matter that is furnished by manufacturers can be judiciously distributed. Puzzles and booklets can be given the children, as one very good way to reach the mother is to get into the good graces of her children.

The good opinion of the press is also very necessary. Public opinion is moulded by the press of the country, and if your local newspaper says nice things about you, the readers will say the same, and it is certainly better to have them say nice things about you than to have them tell their readers that you are a gang of highwaymen, always ready to hold them up, and that your meters are wrong, that your prices are too high, etc. Newspaper men, as a rule, are intelligent people who are open to reason. Take them into your confidence to a certain extent, and they will be your friends. If you have satisfied customers, you will very likely have good friends in the newspapers. It is a kicking, discontented public that usually makes a kicking newspaper.

The good will of the city government is likewise essential, and cannot be too highly recommended. They have it in their power to cause many annoyances, and people are as ready to believe their acts right as they are to believe the newspaper, and, as a general proposition, one is backed up by the other.

DISCUSSION.

THE PRESIDENT—You have heard a very interesting paper by Mr. Perkins on a topic that is one of the most interesting features connected with gas companies—the commercial side. I would be glad to have it thoroughly discussed.

MR. SEARLE—In one community we have had a notable

increase in gas bills, particularly among new houses. We opened up a special set of records to keep track of those increased bills and find the cause of them, and if found legitimate we proposed to maintain that increased business with the old consumers. The investigation showed that the return to the use of dark wall paper had materially increased the gas bills in new homes, where they first depended on white walls for the first year, and then turned to the tapestry papers now in vogue. We found many cases of rooms with white plastered walls that formerly had been lighted by 1 open flame burner, but after the new papering was put on they would need about 3. Of course, then they blamed the gas company right along. We argued that the tone of the paper had darkened the room and satisfied them it was so. This resulted in the installing of 7 or 8 Welsbachs, 3 or 4 of which were used in the dining rooms and libraries, and resulted in an increase among those consumers of 15 to 30 per cent. consumption, all from the use of dark wall paper.

MR. JOHN D. MCILHENNY—Mr. Perkins has so well covered the subject that he leaves very little to be said. I would call especial attention to the advantage of cultivating the sale of gas for industrial purposes. I believe gas companies have neglected that field of their business more than any other, and it is a most desirable field. In industrial consumption the use is entirely throughout the day; it is continuous use, and we all know that the more continuously any product is used the more profitably we can sell it. I think that bills for industrial gas are paid more willingly also than any other class of gas bills. The man recognizes that it is a part of his business. I believe we should use every endeavor to find out the avenues by which we can sell gas for industrial purposes, and to follow them up. I believe that it will pay where a consumer can be secured for industrial purposes to make almost any arrangement with him as to appliances; give him the appliances if necessary, in order that gas may be used. I know personally of several lines which have been developed most profitably by the gas company buying even an expensive appliance and placing it in use upon trial.

MR. SHELTON—I would like to bring out just one point that especially impressed me in that paper; that is the value of newspaper advertising. Of course, all advertising is good, and no one can say any one channel is the only way by which to advertise;

half a dozen or a dozen different ways should be used. But I have had one or two cases of such remarkable growth in towns where we have used the newspapers to a large extent, that I have been forced to the conclusion that there must be even more in newspaper advertising than I have heretofore credited it with. There is one city with which I am connected in which we have carried every week either a full page or half page advertisement. That would cause some of the earlier traditions about advertising in the business to be jarred a good deal—spending such an amount (several thousand dollars) for half and full page advertisements; but we grew in that city last year from all causes—prosperity, coal strike and everything else. We grew nevertheless 79 per cent. from the year before, and while much of that came from other causes, I do feel convinced that our tremendous newspaper advertising, that went into every home (not in half columns or two or three columns, or only part of a page at the top, but over a whole page—gas engines one week, gas ranges another week, changing from week to week) convinced the people that our educational campaign was worth studying. They looked for the gas news each week—I have no doubt it helped us tremendously. In that connection practical politics comes in. It was necessary to raise the price of gas in that city last winter, under the conditions of the cost of fuel. We had been selling for $1, and we put the price up to $1.25. Under ordinary circumstances I think the newspapers would have been pretty "quick on the trigger" and gone for us pretty hard, because it did not cost them anything, and they would probably get the approbation of the public, but knowing that they got a revenue from the gas company of several thousand dollars a year, it made them a great deal more cautious and careful as to what they said. They thought twice before they criticized that raise in the price of gas. I don't mean to say it was undue influence, but I do mean to say if there are fair business relations between the gas companies and the newspapers through the medium of the purchase of space in their columns, it makes the newspapers more reasonable in their point of view, and more fair in what they do say, rather than disturb such existing relations as result from liberal advertising.

MR. RICE—I notice the gentlemen advocates the renting of gas arc lights. I believe that is a mistake. We started to rent gas arc lights in Norfolk, Va., but after a year's experience

became doubtful about it; some began to come back to us. We wrote to a considerable number of our friends, and the replies when they came in surprised us; they were from large gas companies and small ones, and a great majority of them were decidedly against the renting of gas arcs. We have switched around our entire business, and put our gas arcs on the installment basis, so they will ultimately become the property of the consumer. We have ceased renting any more lamps; only sell them on short time. At the present low cost of $7 it is easy to sell them, and once owned by the consumer they will stay in use, while with a constant rental charge we feel they would sooner or later be discontinued. We maintain arcs at a low cost to the owner.

MR. ENRIGHT—I would like to call attention to a little inconsistency on this matter. We are in the electric light as well as the gas business. We put in an electric arc free of charge; I don't know of any electric company that doesn't do the same thing. We sell gas arcs at cost. I would like to have some gentleman tell me why it is that gas companies cannot be as liberal in this line as electric companies. The electric people put out the best inclosed arc without asking any questions whatever. They simply get the best arcs and put them in and keep them in repair; series arcs they trim every day. I have heard of one or two cases where gas arcs were put out free, but they are the only ones that I know of. I firmly believe we could do as well in that line as the electric people do. It seems we are a little too conservative on several points. In pushing gas arcs I don't go around to our electric consumers, but I do call very frequently on the other fellow's people. I simply call and ask the privilege of putting Humphrey arcs in on trial free of charge for a period of ten days, and at the end of that time they can be sold to the party at cost if he desires to purchase them. Out of the first 50 introduced in this way 40 of them stuck. and I sold to those parties at cost. Where it is possible the lamp should be the property of the consumer. I think it is better that he should own the lamp; however, this will be largely a local matter. We keep our gas arcs in A-1 repair free of cost to the consumer, excepting mantles, which they cheerfully pay for.

MR. BUTTERWORTH—Mr. President, I think we are somewhat losing sight of the gist of Mr. Perkins' paper, which is that it is

much more desirable to cultivate the increased use of gas on the part of existing consumers than to cultivate new business. Out in Denver we are so fully convinced of that policy being a good one that we are now putting the major part of our energy into cultivating the use of more gas on the part of existing customers. Heretofore we have been paying our solicitors ("representatives" we call them, because the word "solicitors" has the suggestion of book agency) commissions based on the number of new appliances sold. Hereafter we shall pay them on the basis of the increased gas sales that they produce. I think probably an increase of 5 per cent. on the part of existing consumers is better than an increase of 15 or 20 per cent. secured by means of new consumers. We have gone over our books and calculated about what our increased revenue for the ensuing year will probably be, due to the natural growth of the city, and to the efforts and expenditures that we have thus far made in our new business department. We are going to reserve that increase to ourselves, and then we shall pay our representatives all that they shall make this year over and above that increase. We are virtually going to fine or penalize them for every range they put in, and for every new customer they get requiring a new service pipe; but we are going to pay them liberally for every bit of additional business they get from existing consumers.

MR. PERKINS Something has been said about renting arc lights, and that it was not a profitable thing for gas companies to do. My experience with gas arc lights is, if you sell an arc light, the consumer, through fancied economy, does not change the mantle at the proper time, or they are put in wrong, and the result is the light is thrown out and an electric light put in. I think it is best to rent them, and if you will supply new mantles, keep the lights clean, properly adjusted, and in first-class shape, you have a constant consumer all the time. We do not find it any trouble whatever to renew the leases, but where we have sold outright we have lost nearly 60 per cent. The people we rent lights to are still using them. Where they are put into the house of an existing consumer, we have substituted four lights where possibly he had two.

On motion of Mr. Gimper a vote of thanks was tendered Mr. Perkins for his paper.

The President introduced Dr. W. H. Birchmore, of Brooklyn, N. Y., who prefaced his lecture on

NAPHTHALENE

with the following remarks:

Before I begin I wish to say a word in behalf of my devotion to the analysis of illuminating gas. I have been told half a dozen times during the last year that I laid altogether too much stress on the careful analysis of illuminating gas, and that the books did not take any account of some 15 things which I said could be found in gas if people would take a little time to find them. It has come to my knowledge again this morning that the same protest of unnecessary carefulness has been made to some work which I have just printed. I beg leave to state again that the analysis put down in Hempel is only a scheme to be worked through just as fast as a man can. It groups all the paraffines as methane groups, the $C_n H_{2n}$ as acetylene. In the last edition of Abady's book he draws attention to the fact that two more of the ethylene group may be isolated without a great deal of trouble. The fact is there are 16 ingredients to be gotten out of almost any gas if you will just take a little bit of trouble. Excuse me for talking about a thing of that kind, but it came to me this morning in a way that I thought I could not overlook.

Gentlemen: We may begin this paper and its discussion by asking, "What is this substance, naphthalene?" which is everywhere held as a *bete noir* of the gas works manager.

Perhaps the best statement of the chemical nature of naphthalene accessible to everyone is that in Bernthsen; "Organic Chemistry" p. 498. This author gives in admirably concise statement the following information: "That portion of coal tar which boils at a high temperature, contains a number of higher hydrocarbons, among which may be specially mentioned naphthalene ($C_{10} H_8$), anthracene ($C_{14} H_{10}$) and its isomeride phenanthrene. The first named is found in the fraction between 180° and 200° C., and the two latter between 340° and 360° C. These compounds are of more complex composition than benzene, the molecule of naphthalene differing from the latter by $C_4 H_2$, and those of anthracene and phenanthrene from that of naphthalene by the same increment. They show, however, the most complete analogy to benzene as regards behavior, so that almost

exactly the same varieties of compounds may be derived from them as from benzene itself."

The importance of this statement is great. It, so to say, marks for us the locality at which this inquiry must begin, and it also conveys certain important information. It tells us that the two points between which naphthalene distils are very near each other. It says, "Naphthalene is found in the fraction distilling between 180° and 200° C. But this small range is not due to a high melting point. Pure naphthalene melts at 80° C., less than the temperature of boiling water, but to the intense mutual grasp of this hydrocarbon and its solvents, or those which mutually dissolve and are dissolved by it, upon each other, which makes it so hard to part them.

Transforming these temperatures into those of the common scale, we see that naphthalene distills between 356° and 392° F. This gives the limits between which naphthalene is held in solution as a vapor condensed to fluid as 20° C. and 36° F., a very small temperature range indeed. The quotation continues: "As a matter of fact they (*i. e.*, naphthalene and the two isomeres mentioned) are undoubtedly benzene (benzol) derivatives. From their modes of formation and from their behavior it follows that, in the building up of their molecules, the benzene (benzol) residues combine together in such manner that two, or twice two, carbon atoms are common to both of them." Be pleased to note this statement, that each molecule of naphthalene stands for the destruction of two benzene molecules, two molecules of a substance almost the most valuable to the gas maker, and the incorporation of the residues in a single molecule of this troublesome substance, which we are in practice almost compelled to eliminate as a common nuisance.

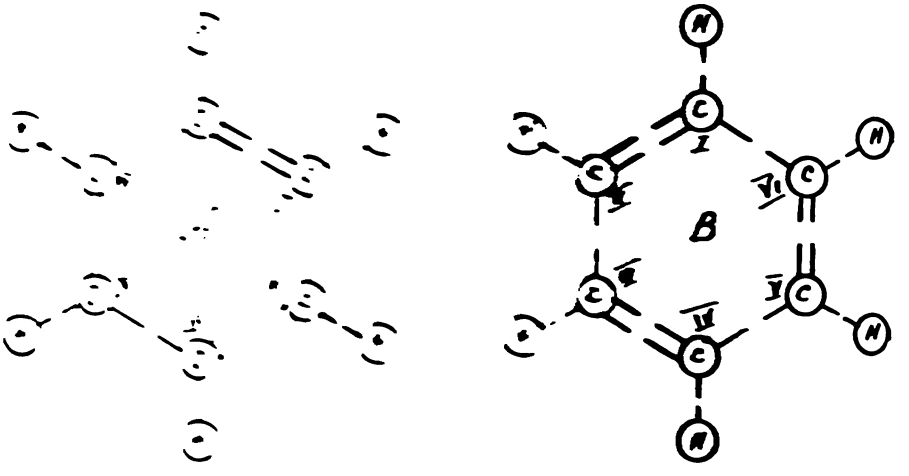
Consider for a moment what this mode of naphthalene formation may imply. We have reason for thinking that sometimes, if not frequently, the practical luminosity, as measured at the gas works on the photometer, as well as the available heat in quite too frequent instance, falls far below the laboratory calculations, calculations based on the results of the analysis of coal and of the gas obtained from the coal, by the laboratory process as employed by chemists making use of the laboratory apparatus. This failure to agree had so often occurred within my experience that I was beginning to doubt the accuracy of the values given

to the constants used, for my results were always too high. But, after much seeking in vain to find it, an opportunity offered to make a comparison between the amount of naphthalene and benzene yielded by a certain sample of coal, which I had examined with special care. When this coal was distilled in the laboratory apparatus to make a sample of gas in order that a study might be made of the product, and the amount of the naphthalene and benzene in the gas made at the gas works from the same coal, of which gas also I had samples taken at various points in the system, a discrepancy appeared, and when it was "worked back" the fact stood out as plainly as any fact could stand that more than 65 per cent. of the benzene which was present in the gas made with my experimental apparatus had somehow disappeared, and that there was more naphthalene in the gas than I could prove to be present in the coal, even allowing that the lost benzene had all gone to make naphthalene. But this only adds a new term to the series, for even if the lost benzene had been converted into naphthalene, thus accounting for the increase in amount of this substance, why did the naphthalene thus formed find its way into the gas; why was it not held back in the heavy oils, or in the tar? To answer this question, to give not an answer which can be at best only partly true and may be wholly false, but to give the answer which tells the whole truth and leaves nothing more to be said, is to have the clue to the solution of the whole problem, is to have the problem of eliminating the naphthalene plague very much in hand.

It is but a fair inference, from general experience and the loss of available benzene, to say that somehow and somewhere in the process of gas making two benzene rings are broken up and that the "residues," the broken rings united, so far as they remain coherent at all, form the naphthalene fetter, this undesired by-product which we are considering. We may, therefore, ask as our first question, "What are the reactions among the gas ingredients leading up to the formation of naphthalene and other like hydrocarbons?" We may form some opinion by study of the question in the laboratory, by experiments in synthesis and corresponding analysis and the after investigation of the results; but before we undertake the discussion of the results which have been attained by such examinations it might be well, in the interest of a better understanding of the chemistry of the problem,

[illegible] symbolic representation [illegible] represent the constituent [illegible] the molecule of the substance. this [illegible]

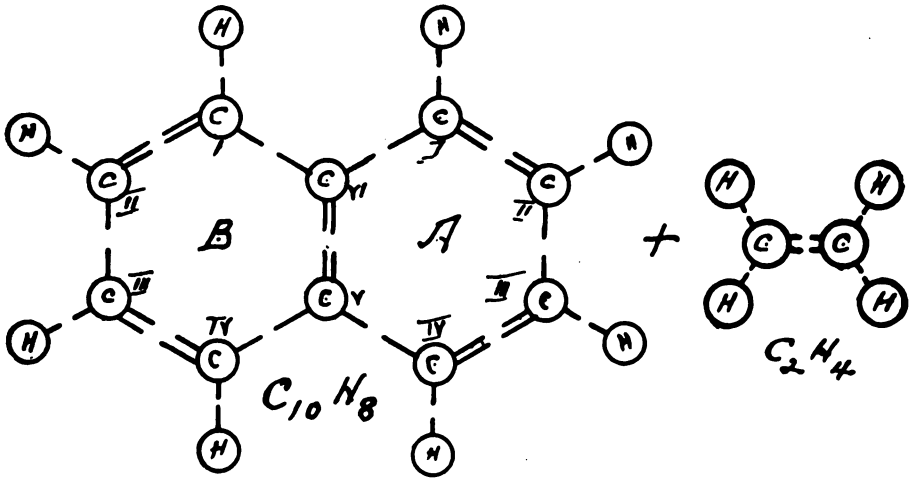
[illegible] dextrorotatory, or right handed benzene [illegible] used to represent a benzene



[illegible] by common consent [illegible] of the numerals on [illegible] possible, the sinistro- [illegible] numerals applied to the [illegible] that of the hands on a [illegible] both rings the carbon [illegible] is in its with four equival- [illegible] We also note that one atom of hydrogen always [illegible] the valence of the carbon atom the so-called centrifugal [illegible] Consequently the various carbon atoms cannot be joined in every case with the same number of bonds; but since [illegible] atom of carbon has an even number (4), we must suppose that they are bound to each other alternately by one and by two bonds, or bands or affinities, whichever one is pleased to call them. Any name may be used as long as its meaning is understood to be figurative. The bonds are known to exist, and we use words having mechanical meanings, but the bonds are not

mechanical. For reasons which are perfectly valid we are certain that the union is physical, whatever its character; and in this sense the bonds might be considered to be mechanical; but when we use the word "link," "chains," "ring," "fetter," and a host of others, the language is purely figurative. It is believed, for reasons which need not be discussed here, that the double bonds form the union between *I.* and *II.*, *III.* and *IV.* and *V.* and *VI.*, while the atoms *II.* and *III.*, *IV.* and *V.*, and *VI.* and *I.* are joined by only one bond. In the dextrotype ring the atom numbered *II.* is on the right hand of that numbered *I.*, while in the sinistro-type ring the order is reversed and the atom *II.* is on the left of No. *I.*

This diagram represents the naphthalene molecule in the same way, and as we call the other the "benzene ring," so we call this



$2C_6H_6=C_{10}H_8+C_2H_4.$

Fig. 2.

the "naphthalene fetter," or "handcuff," names introduced to bring the picture more readily to our minds. As there are two benzene rings, so we might expect as many shapes of fetters as there are pairs of carbon atoms with the double bond, but since we must consider that naphthalene molecules have unions between like pairs of carbon atoms, if we intend to explain their existence methods we are forced to believe that only one naphthalene is possible. In this case we see that two carbon atoms have places

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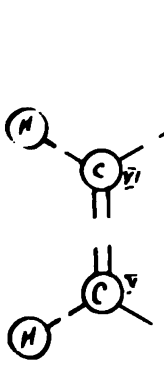

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the rings, and, therefore,
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for the sake of studying its formation, depends on the selection of a suitable material and applying analytical methods, but there is one method depending upon synthetic processes which leads to results most interesting in their meanings.

In order that this experiment may have its due significance, please note this diagram. *A* and *B* are gasholders to which the

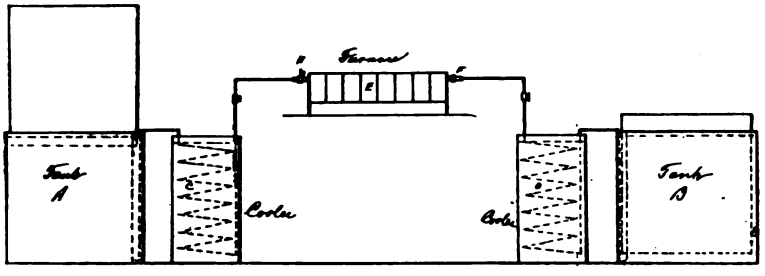


Fig. 3.

gas can be passed back and forth from the filled to the empty at the need and pleasure of the operator; *C* and *D* are coils of glass tubing made to functionate as refrigerating apparatus by surrounding them with cold water, *E*, in which *F* is indicated, is a combustion furnace; and *F* is a tube of iron or porcelain nearly filled with pieces of coke about the size of large birdshot, but free from dust. The purpose is to obtain a large surface with which the gas shall come into contact.

A tube of iron may be used instead of porcelain, and as it is much cheaper, lasts quite as long as it is needed, does not quite but almost as well as porcelain, but it is not by any means without influence at high temperatures. Having got the apparatus together we fill the holder with the gas (holder *A* for instance), with which we intend to experiment, and having passed the gas carefully through the furnace to expel the air, which is allowed to pass out at the burner *H*, and at which burner, when sufficient air is expelled to make it possible, the gas is for a moment lighted, and as soon as the flame at *H* assures us that the apparatus is indeed air free, we pass some of the gas into *B*, so that an equal atmosphere may exist at both ends of the tube, and heat this tube and its contents in the furnace to various temperatures. It is only when the iron has been heated almost to a white heat that its inferiority to porcelain is manifest, and then its influence is

plain enough, for very hot iron is by no means without action on hydrocarbon gases, and results obtained with an iron tube must always be accepted with a certain caution until they have been verified, have been obtained a second time with a porcelain tube or with one of platinum.

Having got the apparatus going let me turn to the same handy text book from which I quoted before and read a note on the formation of naphthalene: "*Formation.*—By exposing a large number of carbon compounds to a red heat thus (together with benzene, styrene, etc.), by-passing the vapors of methane, acetylene, alcohol, acetic acid, etc., through red hot tubes." Excepting the dissatisfying presence of that unwelcome sign, "etc.," nothing could be more satisfactory as a statement than this one. But we do not begin with passing pure hydrogen and the making of the methane, because it is possible but impractical. If we wish to make the higher hydrocarbons, as in the proposed experiment, it is always more simple to begin with at least a few atoms ready linked than to try to link *de novo*, for the sake of avoiding the time loss, if not for more serious reason.

This quotation tells us of the wide range of substances from which this hydrocarbon can be obtained, and assures us of its companions, and it also warns us to consider how diverse and how many its formation methods must be. The reactions which actually occur in our experiments in making naphthalene, as the by-products of the making, should never be regarded as analogous in any two series of reactions until this question has been submitted to examination and the fact of the analogy proved; much less should identity be assumed, for the widest divergence is in fact possible at any time. It does not require much experience with chemical investigations to understand that we have in hand one of those studies in which the results actually obtained by our experiments depend almost without exception upon the exact management and nice coincidence of conditions, and most important for success is skill in the nice details of the numerous manipulations. But since the conditions are almost exactly those of a retort in a gas works, the results are sufficiently interesting and important to justify any amount of time put in on the study. I believe I could spend hours instead of minutes in telling of the details of experiments made with such apparatus and do so with profit. It would be increasing the fund of

information at hand on the art of gas making, for the form of the apparatus is quite secondary; the fact of importance is the interaction of gases and coke.

It was my intention to avoid the use of chemical notation, but to explain chemical facts we must use the language of chemistry, and, therefore, to an extent this notation must be used. However, I will explain all the glyphs and grams, and I promise to use them only when I find that I am compelled to do so, and when I do make use of this notation I will try to give full explanation of the symbols, and of the facts which they are intended to represent to the mind's eye.

You all know that the hydrocarbons are divided into two great series; those whose formula are indeterminate and those which have determinate formulæ. In the first series substances are changed from one to another by simply adding atoms or groups of atoms, but in the second series we must take the molecules to pieces to make a new one. That is, in the first series the formulæ, as representations of substances, have no definite limits within the series in respect to the number of atoms which combine; the other series presents for study many instances of such limits. We may express the same fact by saying that one series forms addition products and the other does not; that is, not in the same sense. Contrary as it seems to usual experiences, however, it is certain that there is a transition between the two series of substances, and that this transition is possible at more than one place in the series, and that such a transition takes place in the experiment which I have described is perfectly certain. As the gas is passed once and again over the coke there is a change from one molecular form to the other. It is also a fact that, as we pass the red hot or white hot gas, for the gas in its passage is heated until it is as hot as the coke itself, most wonderful changes are produced by this mutual action both on the gas and on the coke. Sometimes the amount of hydrogen free in the mixture will be very large, and again it will be reduced almost to none at all; then, again, this gas will reappear, even in large quantity the amounts of the various gases depending upon variation in temperature and the constant action of the law, that all molecules contain a maximum of hydrogen at the instant of formation, and all in like manner contain a minimum when they have become stable. When the free hydrogen

disappears we always find that it has been engaged with carbon from the coke to form new molecules with a maximum of hydrogen which molecules will in their turn go through the same series of changes from the less to the more enduring. On account of this power of the hydrogen atoms to react, a number of times in succession and each time with new atoms of carbon, it seems not improbable that a large part of the coke might be converted into the most complicated of the hydrocarbon forms found in illuminating gas, not into methane and ethane only, but even into "green oil" itself, were but time enough allowed.

We return to our apparatus and its uses. We fill it with a hydrocarbon easily made in the laboratory, and the least complicated of all hydrocarbons, one which has a molecule containing only one carbon atom. We fill it with methane, marsh gas. We pass this gas very slowly through the heated tubes, so that it has time to come into the closest possible contact with the coke and to be heated to the same temperature. During the passage a great change takes place. We pass into the tube methane and a trifle of watery vapor, but we find that other than these come out of the tube. These changes we call synthetic reactions, and in the language of chemistry we express them thus: Watery vapor, coke and methane reacting, give opportunity for the formation of carbon monoxide, ethylene and ethane; hydrogen remaining free, and also carbon, with the most part of the methane unchanged.

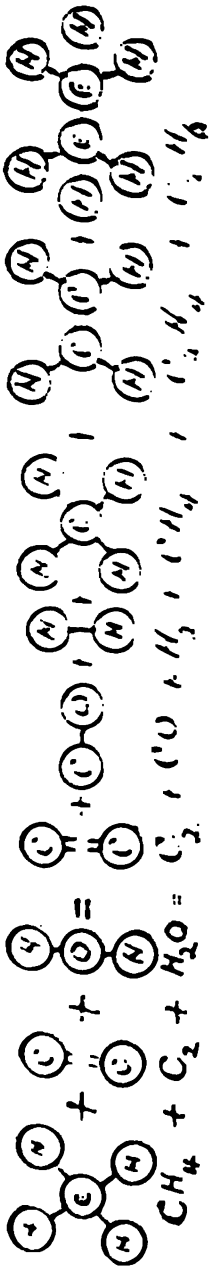
As has been said this is the first reaction which can be surely said to occur, and it is well to consider it with some care, because it is in a way typical and simple itself; it foreshadows all the complicated reactions which are to come after it. Written with structural formula the reaction appears to take form as follows: We consider only the atoms taking part in the reaction, only the molecules which actually undergo the changes, and these only in respect to the proportions made use of, not in actual amounts of gas reacting nor in respect to the number of molecules concerned in the reaction.

Beginning with carbon and water, we have, first of all, this reaction: $C_2 + 2H_2O = 2CO + 2H_2$, the fundamental reaction of many processes in gas chemistry as well as in metal working, in making gas as well as smelting iron. One volume of carbon vapor has united with two volumes of watery vapor, steam, to produce two volumes of carbonic oxide and two of hydrogen, or

we may imagine the equation on the gramatom basis, and say 24 grams of carbon have united with 36 grams of water to make 56 grams of carbonic oxide and 4 grams of hydrogen gas.

This process continues as long there is any watery vapor to react on the carbon, and the increase in volume from the reaction is very perceptible if the reaction is long continued. The next reaction is far more intricate, but also more important in the premises: $4CH_4 = C_2H_6 + C_2H_4 + 3H_2$. This tells us that 4 molecular volumes of methane, when sufficiently heated in the presence of hot carbon, react together to give 1 volume of ethylene, 1 of ethane and 3 of hydrogen; or, making use of the gramatom values, 64 grams of methane have given place to 6 grams of hydrogen, 30 grams of ethane and 28 grams of ethylene. It is probable that in all these changes, and in a very great number of others like them, the carbon in some way acts as an excitant, a producer of molecular disorder.

No one can pretend to say why the change begins in this manner. No one of us can tell why the decomposition should not be followed by the conversion of all the atoms concerned in the reaction into ethylene, or all into ethane, or, as it has been most happily termed, di-methane, without the formation of any other hydrocarbon. Nor can anyone say why it is that when the change has begun it fails to continue until all the methane has been changed into the relative forms; but it is not thus the change is destined to proceed. It seems almost as if the loosened molecules had a kind of difficulty in forming satisfactory unions, for by gradually extending the heated space in the tube, and at the same time making the gas to pass very slowly, more and more complicated molecules are gradually built up. When this process of formation begins *de novo* the new formed molecules are always found to be members in the two series which have been indicated above, either in the series $C_n H_{2n+2}$, or in that of $C_n H_{2n}$, in the series of methane or of ethylene; but while cases of the formation of new molecules occur in both series in nearly equal degree and at nearly equal rates, reckoned as new molecules per minute, there seems to be a great difference in what may be called the relative power of survival of the members of the two series of molecules, both as group series and as individual molecules; as it were, a difference in their abilities to withstand the struggle for existence in their special environment. In regard to the



development both of individuals and series, certain facts have been observed which may be regarded as almost invariable, and from these facts a theorem has been devised usually spoken of as the law of their formation. This law may be formulated thus: Beginning with methane, we consider that the carbon atom is centrally placed with respect to the hydrogen atoms, and that these are so situate that their centers of gravity are all equi-distant from the center of gravity of the molecule. We may imagine the plane of projection to be parallel to the surface of the paper, in which case the constitutional formula would be written

See Fig. 4.

Ethane, to which the name di-methane has been applied, may be considered as two methane molecules which have lost an H atom each and then have united. It is, therefore, a very simple formation as derived from methane. The equation of the reaction would be $2CH_4 - C_2H_6 - H_2$, or, if written glyphically, it would be written thus: (See Fig. 5).

We can conceive this glyph as extended indefinitely in a horizontal direction, by supposing the H atom on the horizontal line to be dropped and another methane molecule added, which had already lost an H atom.

In this way are formed the glyphs with which the formulæ of the petroleum paraffines are found to agree; and when all has been said and done it is by no means unlikely that we would be justified in saying, and with which their molecular composition is found to agree, the list would be prolonged uselessly were all the possible items named, and while some of the hydrocarbons are well known to all, at least by name, others, it may be confidently said, are not even names. Methane, as every one knows, is "fire-damp" and "natural gas." The pentane, butane, hexane groups found in gasoline are series of isomeric hydrocarbons, and higher members still of the same series are found in the high test kerosenes and so on; more and more complicated molecules, with high and still higher boiling points, through the various paraffine oils to paraffine wax.

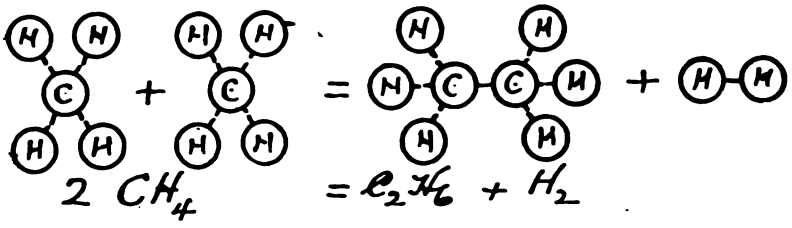


Fig. 5.

We may consider that the ethylene group is formed by complicated change from the methane nucleus, but in this case two hydrogen atoms are dropped, usually as symmetrical pairs, and not one by one, as symmetrical individuals, and the link system called "the double bond" appears.

It is worth our while to remember that the higher members of the paraffine series, judging by reports of analysis, practically disappear in illuminating gas. After the second member ethane we find no more, and this one but infrequently. It must be remembered that no matter how much nor how many of the higher members of the methane series might be present in a specimen of gas, they would all be reckoned as methane in the at present most commonly employed of the analytical schemes. Nevertheless it seems to be a fact that the members of the ethylene series do take the places of the methane series; that is, the members of the series $C_n H_{2n}$ are found instead of the members of the series $C_n H_{2n+2}$.

As the amount of coke which is heated in the apparatus which has been described, attains to a red heat and still higher temperature, and thus in equal rate increases the amount of white hot coke which the gases meet in their passage along the tube, so does the amount of ethylene ($C_2 H_4$) converted from the broken methane (CH_4) molecules by the action of the hot coke increase. Presently we find also propylene ($C_3 H_6$) the second olefine, and then butylene ($C_4 H_8$), the third. It is worth noting that just as all the paraffines are, by the ordinary text books which teach the course of analysis lumped, as methane (CH_4), so all the olefines are commonly lumped, as ethylene, as if the writers of such text books were convinced either that the task of separating the individual gases in each group would be too much for the industry or the understanding of their intended readers, the chemists in the gas business. Propylene ($C_3 H_6$), is usually reckoned as a true gas, since it functions as such at 760° mm. and 0° C., and as such is usually found in all coal gas samples, but not so all three butylenes ($C_4 H_8$) for there are three of them, with the same chemical, but very different physical characters. Amylenes ($C_5 H_{10}$) five of these are known—will sometimes be found, if they be looked for, and the two low boiling hexylenes ($C_6 H_{12}$) the isomeres of that remarkable substance and important gas ingredient cyclo hexane. This latter, almost never reported and seldom identified if found, is probably the ignis fatuus, the fatal fire, by which the transition to benzene is made at a high temperature. These important substances are almost never mentioned in books of instruction in the art of gas analysis, and if one questions the writers of these books for the reason why of the omissions he gets for answer:

"It takes too much trouble to make such analysis and too much time to figure them out."

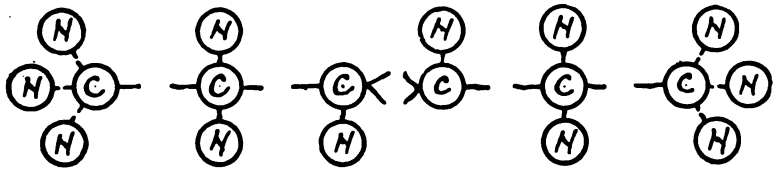
Unfortunately this is not sarcasm (would it were), but the words of a man who has thrown all the influence he has, and it is much, against the increase of information among gas men concerning the chemistry of their product.

The transitional character of cyclo hexane has been mentioned previously. It seems to indicate the path by which the olefines, or it may be the paraffines themselves, pass into benzene and higher compounds. It is not my intention at this time to follow

this path out step by step, but only to indicate certain facts as rapidly as possible.

The olefines form a group by themselves just as the paraffines do, and in each new change of form n groups of the lower member are converted into n — 1 groups of a higher, if the changes take place within the series, and not by dropping hydrogen atoms from a paraffine.

When hexylene (C_6H_{12}) appears a remarkable transition comes with it. There is no real break in the chains, only an unexplained transition, yet the apparent break is complete.



C_6H_{12}. Fig. 6.

Starting with an unquestionable paraffine, methane (CH_4), without any other manipulation than the passage of the gas over hot carbons, the entire series can, if time and patience are forthcoming, be built up. The conversion is only partial in amount in any experiment series because of the time limit put to it by human patience and physical endurance; but however deficient quantitatively, it is a perfect success qualitatively up to this point, to the appearance of hexylene in a relatively large quantity.

Sometimes it appears that other paraffines than di-methane, ethane (C_2H_6), are noticed even as early as at the end of the first quarter hour, but benzene sometimes appears quite as early as the first named paraffine, and a gas which was first supposed to be hexylene (C_6H_{12}) has been found before less complicated members in the chain. Consideration of such circumstances makes one to raise the question: "Is it hexylene?" And further study of the problem seems to suggest another explanation of a series of apparent contradictions, which are certainly not easily reconciled or explained.

As I have said before, if the experiment should stop short at hexylene this development would be orderly. We can easily and accurately explain every step in the chain, but if we persist

in our experiments of passing the gas back and forth over the hot coke something happens for which no sufficient explanation has yet been given. Benzol, a member of another class of hydrocarbons, a ring and not a chain, as all so far have been supposed to be, appears; and following on this, naphthalene and then anthracene.

It is hardly a figure of speech to say that when one who is thoughtfully inclined to demand a reason for all he sees becomes for the first time fully conscious of the tremendous consequences dependent upon the seemingly trivial acts and processes of this experiment, he in truth is astonished, and thinks, if he does not say: "From whence are these?" Presumably from cyclo-hexane, and this is rendered more probable by the invariable appearance of large volumes of hydrogen at the same time with the benzol, which volume of hydrogen would surely appear were this the mode of transition, but which no hypothesis, no matter how ingenious, can logically account for on any other theory, unless the offered theory will also make explanation of the thermo-dynamic curve. We may consider normal or ortho-glyphtic hexane to be represented by a chain of 6 carbon atoms in a horizontal row, 4 of which are joined to 2 atoms of carbon and 2 atoms of hydrogen each, while the other two, the first and the last, are joined to only 1 carbon atom and 3 hydrogen atoms. At either end of the atom chain which constitutes the molecules is a single hydrogen atom, either of which removed permits the addition of new groups at the end it guards.

The high school theory of the formation of the ethylene series from the series of the paraffines presents theoretical difficulties nearly insurmountable on account of the double bond. But if, as has been suggested in this paper, we abandon these puerile attempts to step on every figure of the carpet, if we content ourselves with saying that all the hydrocarbons are formed by additive rearrangement in independent series sometimes, and they do not always exist even as interdependent series (although, principally because it is so difficult to prove the contrary, it has been permitted to certain writers to maintain unchallenged the unproved hypothesis that the higher members of the ethylene series are formed from the lower instead of from the corresponding paraffines), yet the time is coming when this question of the point and method of origin will be so important practically that

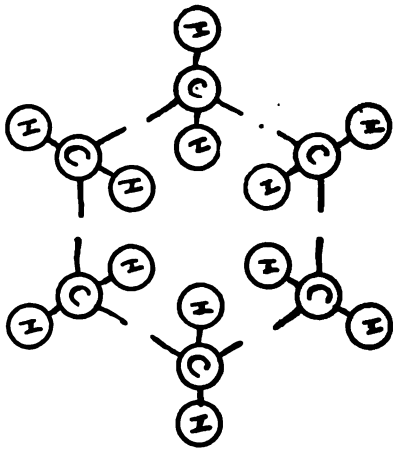
no doubt can be longer tolerated, and then we who are in the minority will have our hearing.

Two molecules of marsh gas become one each of ethylene and hydrogen by the two carbon atoms letting go two pairs of hydrogen atoms, one pair each, presumably H_2 and H_4. The interior atoms, as they are sometimes called, and the carbon atoms might be supposed to take a firmer hold on each other, to use a figurative expression.

If we accept the theory that all of the four valences of carbon are equal this is simply inexplicable. It can no more be explained on this basis than the substitution of other monovaliants for hydrogen in methane; but if we admit a distinct "polarity" in all atoms this difficulty is out of the way once and forever, and we have two explanations, either that the hydrogen atoms of the same polarity, so to say, are dropped from both molecules, or the hydrogen atoms of the opposite polarity, and there is much reason for accepting this as true. This hypothesis, of course, supposes the existence of two kinds of atoms, one "dextro-type" and the other "sinistro-type." On this theory all the free gas molecules, as the oxygen in the air, will consist of two atoms of opposite names. The existence of the two atoms has been long known. The claim for distinct polarity is relatively recent in its formation, but it explains *why* a certain condition exists, which explanation has hitherto been wanting, and incidentally this theory gives the explanation of the change from methane to ethylene, from this same methane, as well as from other paraffines, to various ethylenes and other hydrocarbons, one after another, until cyclo-hexane makes its appearance, for a moment, to give place by dropping hydrogen to benzene, and the first hydrocarbon series is complete.

If six half ethylene molecules or six methane molecules partially disturbed, mutually attracting each other, approach towards their common gravity center it is plain that the union which they would probably form would be a ring-shaped molecule, in form such a molecule as cyclo-hexane is and with all its bonds equally strained. In other words, a molecule in the form of a closed circle would appear, and such a molecule certainly exists in cyclo-hexane, and this would convert into benzene, by the simple process of letting slip six hydrogen atoms, the interior six to unite as three pairs of atoms, as the molecules $3H_2$, and it has

been shown again and again that the hydrogen formed into molecules just corresponds with this theory, as does the disappearance of the methane and the appearance of the benzene.



Molecule Cyclo-hexane.

Fig. 7.

Now, please consider what deduction may be drawn from the experiment I have spent so much time in describing, and about which I have said so many words. Let me name the facts brought out as rapidly as may be: 1st, as soon as the carbon has attained to a red heat for the space of an inch or so in the tube, so that the passing methane began to be heated red hot by contact, ethylene began to appear in the gas volume, the amount increasing with each passage of the gas over the hot coke; 2d, as more of the carbon was heated the rate of formation of ethylene increased in equal measure and some small parts of the new formed ethylene went to form higher members of the series by simple addition, or rather the higher members appeared and the rate of the appearance suggested this method of origin; 3d, the bulk of these higher members was indefinite and never large, and their relation to the ethylene series could not be stated except by analysis; 4th, when a large part of the carbon in the tube was red hot, so that the action on the methane and other gases was very powerful, a new phenomenon appeared, as it were, suddenly—

benzol was formed; and 5th, in some instance when the experiment was prolonged naphthalene was proved to be present in large quantity, and always in small quantity when the experiment was continued sufficiently long to demonstrate the benzene positively.

This history may be regarded as that of the formation of the hydrocarbons by synthesis, and we must regard it as one of the ways, and possibly as the way, or as the most likely way, in which all of them were formed at first "in the beginning," in nature.

Two other methods of origin for the various ingredients of an illuminating gas must be considered as active during the process of gas making. We must admit this. Basing the admission on experience we have heard of what sometimes happens when we are distilling a cannel coal, or any gas for that matter. Under such circumstances we find that sometimes, perhaps frequently, large amounts of all these series of hydrocarbons exist in the coal stored up by occlusion. They are part of the mass as the water is part of a crystal, or as water is an essential part of a piece of sugar candy. They are present for liberation, and when heat is applied they are freed from their bondage and are able to functionate independently. But while the amounts thus liberated are large, and practically represent the whole of the gas obtained at a low red heat, they do not by any means represent the total yield. This is shown by the way in which the preformed oils distil over from time to time, as the coal is heated in a laboratory experiment. At the same time one is convinced that certain of the hydrocarbons are so intimately associated with the coal that only the very highest temperatures will liberate them, and that these complicated molecules are not infrequently broken up into the simplest forms before they are shaken free from the carbon which holds them. Here also we learn that this separation is only temporary, atoms, groups of atoms, sometimes whole molecules, once and again uniting to produce unexpected compounds.

This possibility of formation of naphthalene from the higher polymeres is important, and forms another and distinct origin for the naphthalene in the coal gas, since under the long continued influence of great heat, obtained at an expenditure of fuel perhaps unwise, the members of the naphthalene group of higher boiling

point are "cracked." In other words their molecules are broken up, yielding acetylene for use as an illuminant and much naphthalene. The constitution of these hydrocarbons is interesting as are also their physical properties. In number they are three, one anthracene and two phenanthrenes, a dextro-type and a sinistro-type molecular form, which pair of true isomeres probably, for a wonder, presents no known physical unlikeness, probably because we are insufficiently acquainted with them. Their boiling point is high, so high that it is set down simply as "above 351° C." in the case of anthracene, and they are, therefore, still fluid at a temperature under whose influence naphthalene is already a gas. Since the members of this group must be considered together the formulæ and relations are stated as below. Naphthalene distils between 180° and 200° C. scale, anthracene comes over between 340° and 360°, and phenanthrene accompanies it. Therefore the thermometric distance between naphthalene and these two oils is greater by one-half than the distance between ice and steam.

The benzol formula has been discussed together with the symbol used to indicate it, and the relations were shown by which the naphthalene fetter is established and maintained. The two formulæ which follow those of this isomeric trio must also be looked upon as, like naphthalene, derived from the benzol ring. In naphthalene a dextro-type and sinistro-type benzol ring are combined, so that a V.-VI. union exists, as shown in the diagram. In anthracene an acetylene molecule apparently is joined to two benzol rings, one dextro-type and one sinistro-type, the acetylene molecule coming in between and functionating as the link connecting them. The result is the same as if 7 molecules of acetylene had combined.

In phenanthracene an exactly similar series of molecules is engaged, but in this case the no longer central, but eccentric, acetylene molecule joins itself to a pair of dextrotype rings already connected by a union between C_6 and C_1, almost an unique linking. A sinistro-type form also exists which agrees with this in all respects, so far as known—should a difference between them be discovered it will be interesting indeed—but the principal practical usefulness of such a demonstrated difference would be to quiet the discussion in regard to the fact of the existence of both forms. Then the fact of their existence will be no longer open to the

"doubts" of certain men, and the reputations maintained by wise objections will not count for so much. It is to these two oils that the solution of the naphthalene was once due. When pure they are solids at the boiling point of water; anthracene melting at 213° C. higher by 13° C. above water's boiling point than this boiling point is above water's freezing point; but phenanthracene melts at a comparatively low temperature, 103° C., hence when mutually dissolving and dissolved and in solution of and with other hydrocarbons they are nearer to ordinary experience. Commercially these oils contain both of the $C_{14}H_{10}$ isomeres; also some naphthalene and benzol, and it may be even lighter ingredients still.

The relationship between these hydrocarbons is shown by the accompanying diagrams of the molecules in juxtaposition for the sake of comparison.

Fig. 8 is a right-handed benzene ring. Its mate, the left-handed ring, has been illustrated and described.

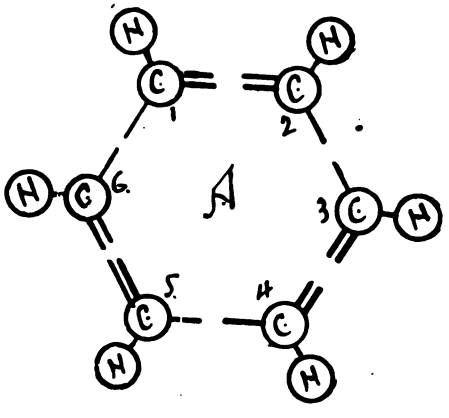


Fig. 8.

Fig. 9 is the pair of interlocked rings. The right-handed benzene ring interlocked with a left-handed benzene ring along the line of the double bond, the two rings having two less carbon atoms and four less hydrogen atoms after combination than before.

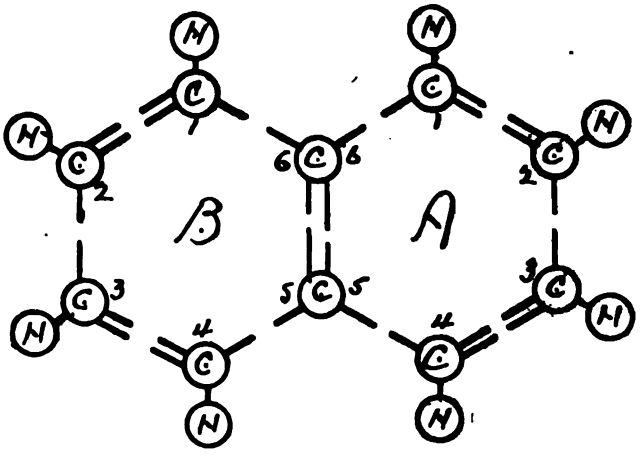


Fig. 9.

Fig. 10 is the classic representation of the "anthracene"

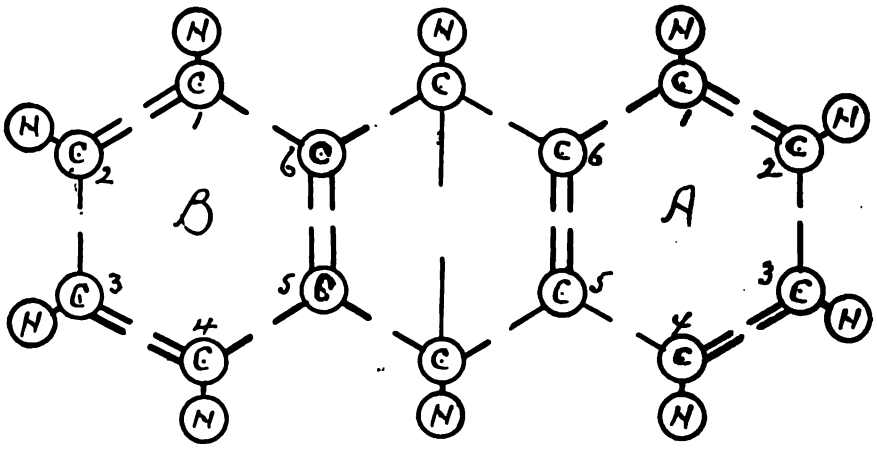


Fig. 10.

molecule. The name is derived from a Greek word meaning "black." This molecule is formed in exactly the way theory indicates it should be. Two molecules of benzol in the process of combination to naphthalene have begun disintegration, have dropped H_5 and H_8 from both rings. At this point an acetylene

molecule has entered the combination, one of the links of carbon atom (a), uniting with carbon atom A_6, the other with B_6, while the third link joins carbon atom (a) to its corresponding hydrogen atom, and the fourth union is with carbon atom (b), as shown. The linkages of carbon (b) are understood to be in the same relative order. The triple bond between the two carbons of the acetylene molecules are thus reduced to one, the others satisfying the affinities of the benzene rings in places in which hydrogen has been dropped.

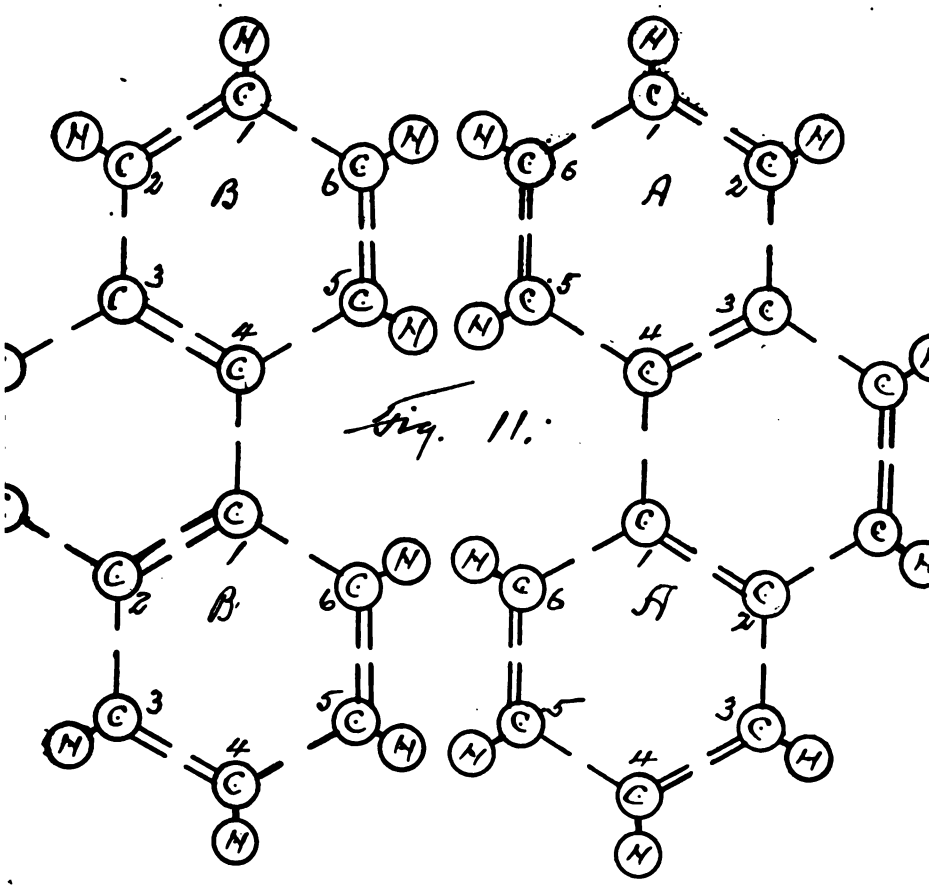


Fig. 11.

This is the diagram which represents the most usually accepted view in reference to the constitution and various relations of the

two phenanthrenes. It will be noted at a glance that these two glyphs, one representing a right-handed molecule and the other a left-handed one, differ radically from any others yet in question. It will be noted that the two rings are forms of the same name, that both are right handed or both are left handed. One also notes at a glance that these two rings are directly bound by the external valence of C_4 in the superior group uniting with the external valence of C_1 in the lower group; also, that the acetylene molecule has now only centrifugal relations. It is not in this system the central molecule, as it were the nucleus of the system, but it is excentric and distinctly asymmetrical. It is also to be noted that there is double linkage between the carbon atoms of the added group, the so-called "acetylene subsidiary molecule," instead of a single linkage only, as in anthracene.

It is worthy of note that while both of these forms, anthracene and phenanthrene, are produced by acting on the vapor of benzol with acetylene gas in the presence of hot carbon, the probable use of such carbon being to maintain the temperature of the reacting gases, when decomposition of the molecule takes place the resulting gases are not benzol and acetylene, but in the case of anthracene are di-methane, $C_2 H_6$, ethane and almost useless (to the gas works manager) paraffine, and the quite unwished for naphthalene; while if phenanthrene is broken up the product is naphthalene, the far more useful ethylene $C_2 H_4$ the first olefine.

(If the audience will permit I wish here to substitute demonstration and exhibition, during the next few minutes, in the place of description.)

We have, I think, considered the chemistry of the substances obtained from coal by distillation sufficiently to make understandable at least the proposition which I propose myself to formulate in the balance of this paper. We know that if the retorts are worked at a certain temperature (A), the naphthalene is not a nuisance, but if they are worked at a higher temperature (B), the naphthalene is a nuisance. These facts are capable of easy demonstration. The difficulty in the situation is found in the following: The gas maker insists that he must have the use of the higher temperature, since without it he cannot make gas with economy, either in quantity or quality. Granted that this assumption of the gas maker (it is really nothing but an

assumption except in relation to one system of working) is true in fact, then from his standpoint the production of the naphthalene nuisance, as a chemical and mechanical condition in practice, is inevitable. What has been done to make it so?

The only change apparent in the chemico-mechanical scheme on which the gas making apparatus is worked, except the inevitable change in the raw material from time to time by supply-exhaustion, is the change in the temperature gradient and routine of changes according to which the retorts are worked, yet this change stands for a more or less complete destruction of the various olefines and paraffines, the poly-acetylene also it may be, finally the anthracene and phenanthrene molecules, and the formation and precipitation of naphthalene. Investigation seems to show that the result of the present temperature schemes and their application in the retorts are just what we would expect to find under the conditions specified. The net result of it all is the "cracking" and destruction of the solvents, the anthracene and phenanthracene molecules.

This secondary formation of naphthalene is the result of the ordinary manipulation procedure in the gas works, just as it the result of this system of manipulation and order of process in the laboratory. Given the conditions of the experiments, the results in the small laboratory do but typify the results which follow in the large one. The results in both are alike in all essential points of sequence, apparent cause, and secondary results, differing only in the scale on which the experiment is made, in the size of the working.

To test the theory just outlined, experiments were made with all due care in an apparatus which I think may justly be called a miniature gas plant. The details of some parts are shown in the diagrams. The idea held constantly in view in the design of the apparatus is, not to save the gas alone but to save everything which is obtainable from the coal, and to save this everything in such way and form that it may be examined at leisure, and thus not only may the various substances produced be definitely determined and their grouping studied, but also we may learn what will happen when changes are made in the details of the treatment, in the temperatures used and the grouping of the various products.

The coal is distilled in the retort (A), and from the very

orifice, from the very point at which the retort ends and the secondary apparatus begins, the products of distillation may be either parted into groups, or individual products may be separated, or all may be allowed to go on together. Thus, at a selected point the tar and gas may part, the tar descending to the tar well by gravity, or by pumping in one of the many ways, while the gas, tar free, goes to the condenser and thence to the purification apparatus. Owing to the length of the condenser the temperature of the gas can be lowered to that of melting ice, to the Centigrade zero, which causes all ingredients which are "condensible matters" to change their physical form at a rate as rapid as that at which they give up their heat, those which become solid fixing themselves on the walls of the various condenser tubes to be removed in due season, the liquids flowing into the receptacle provided for them, the true gases saturated with the vapors of various liquid hydrocarbons going on to the holder reserved for retaining them.

As an alternative process the oils and the like could be sent into the secondary furnace where they would undergo decomposition in contact with white hot coke without mingling with the true gases, and leaving this tubular furnace they could be sent through a condenser at any chosen temperature, or the gases, vapors and fluids might be parted from many others as those just mentioned were.

In such processes as gas making, separation and recovery are at all times more or less collateral terms, because the second practically implies the first. Still another alternative is possible, both oils and gases can be sent through the hot tube, through the heated tubular reaction chamber, so that they may, if they will, react on each other while at a very high temperature, and thus the result of their interaction may be noted. As an alternative to immediate separation the gases and oils may be permitted to remain in contact and to react on one another for an indefinite period, The investigation of a coal supply with such an apparatus requires us to make gas from samples of such supply in not less than three, and it may be in 12 different ways, and such investigation also implies an analysis of the gas and of the tar of the most searching and rigorous order.

Let me say in passing that since this question of the naphthalene nuisance was brought to my attention, now some years ago,

I have studied at my leisure, and with as much care as I am able to use, more than 20 samples—to be accurate, 26—of coals, using in the study the very best apparatus and ample time. The advisability of publishing some of the results obtained was repeatedly suggested, but as the matter seemed one of academic interest and of no practical value no publication has been made or even planned for; but considering the problem in relation to naphthalene alone it may be that some few of the many observations made might have a practical bearing on the matter in hand.

In the first place I wish to take up the subject of the amount of naphthalene in the various coals, without applying such investigation to this question, to the discussion of naphthalene in illuminating gas, but simply as a matter in science, in chemistry at large.

When your President sent me the invitation to address you he laid stress on the discussion of the influence of the coal, as a part of the suggested scheme of my paper; that is, he specified the influence of the coal used upon the naphthalene production as a topic, as one of the points he thought should be discussed. It was with some surprise that I read the sentence, for wide as I knew your President's acquaintance with what I may call the laboratory side of the gas maker's art to be, I did not know that he had, even at any time, considered this part of the subject, which almost always escapes the lucubrations of the practical man.

I do not intend to say that the practical are not fully awake to the influence of the coal used upon the production of the naphthalene nuisance, for they cannot but recognize the fact that when they are using some coals there are troubles, and when using other coals there are not, but that instead of saying we will not use this coal on account of its naphthalene, they object, not refuse, and then abandon the objection, where the coal company gives them a discount, only to complain when the naphthalene asserts itself, as it surely will in time.

The fact of the matter is that the influence of the selection of coal is not the least of the possible factors having influence on this problem. It is not a negligible quantity; it is very far indeed therefrom. It is not my intention to name any special brands, the product of any individual mines, nor to be very explicit in

statement, because by so doing I might do a serious injustice both to my hearers and to the coal dealers, who are absent, and also because the coal supplies with which I would be dealing are those of bygone times, of last year, or the years before that; not with those of next year which now interest us; and besides, the certain, if gradual yet constant changes in the quality of the coal mined insure that the supply of to-day cannot be judged by that of last year, nor that of the future by the present. Understand me, therefore, to be speaking wholly of last year and not of the hour.

For the purpose of the discussion which we have in hand we may divide all coals containing sufficient volatile hydrocarbons to be of practical use in gas making to rank them as gas coals, into three groups: (A), those which contain an excess of solvents; (B), those in which the naphthalene and the solvents are to all intents and purposes in an almost exact balance, as if the solvent substance had been saturated with the substance dissolved; and (C), those in which there is an appreciable excess of naphthalene to start out with. It may be urged that I am anticipating my discussion by thus speaking of the "naphthalene solvents;" but in the present state of the art, and of the naphthalene discussion in societies and in print, especially in the periodicals devoted to our interests, it can surely be forgiven me if I assume that an audience of specialists is familiar with circumstances and arts germane to, even if not directly connected with, their proper profession, their daily business. In a coal in which the solvents are in large excess a great part of the solvent oils can be broken up and still leave enough to keep the naphthalene in solution, the nuisance in hand, most surely, of course, if attention is given to the important question of proper working temperatures; but when the oils are saturated at the very outstart the least disturbance of the balance will simply overwhelm the works with the surplusage of the naphthalene, and this is just the result attained when the oils are broken up in practice.

At the same time it must not be supposed that a coal supply of say 20 car load lots can be so sampled that an assay of say 5 pounds can be trusted to determine the amount of naphthalene and its relations out of hand. To illustrate this: In March, 1898, a sample of coal was sent to me containing 5 distinct layers. The

pieces were large, the four sent weighing fully 50 pounds, and and they seemed to represent the entire thickness of a vein. Four of these layers were perfectly distinct and entire; the fifth was very much crushed and broken, showing that it disintegrated much more rapidly than the others, so that it would afford practically all of the "crumbs and sweepings," and in a clean-up these would furnish more than their just proportion of the charge. It suffices to say that the layer containing the most naphthalene exceeded the average by 30 per cent. while the one containing the least fell 28.3 per cent. below the average. So, then, a charge made up largely from the dust and crushed coal from the floor of the shed would have given no trouble, while a charge made from pieces selected for their fine appearance would have made so much naphthalene that, if the management were taken by surprise, it might well have been overwhelmed. In another case the average of 10 samples of 5 pounds each, taken from the coal used in 1900, contained only 60 per cent. as much naphthalene as did an exactly like sample from the coal used in 1902, but the 1902 sample contained so much solvent oils that there was no naphthalene trouble during its use, while complaints were constant two years before. This strange (for with our present meagre data it is not to be accounted for) variation explains why some men regard naphthalene as something without known laws, and almost as an "evil-jin." Others declares it a bugbear, and others again will name it a nightmare.

In some cases naphthalene seems to hold such relation to its solvents that it may play the very mischief with the peace of mind of the works' manager, because it may appear anywhere in the distribution system at any moment. Twice I have written letters to the managers of gas works asking for definite information about this nuisance, only to receive in reply their positive assurance that the naphthalene problem really had no existence except in the superheated imaginations of inexperienced men, yet in both instances I had from them later on coal samples and requests for any information I could give in relation to the naphthalene nuisance. By reason of these facts, and from the consideration of other like data and information items, it seems to me perfectly absurd to say, as so many do, that all the difficulty in managing this ever present phantom, which all fear as threatening if not actually busy in the pipes, is due to

the incompetency of the gas works' management. Such explanation is absurd; such implication is a slander against which the rest of us have a right to protest.

As specialists trained in the practical work of their art the American gas men are as competent, as ready, as forehanded, as are the chemists engaged in any other industrial occupation in the whole, wide world. That proposition I am ready to maintain anywhere against all comers, but I do not think that the gas works' managers call to their aid nearly so much as they might the skill of those who stand ready to aid them with head and with hands, by the use of technical skill spent on examination and selection of the best raw material. It is not so very difficult a matter to tell from a fair sample what the experience of the user of any given coal is likely to be in regard to this troublesome intruder. If all precautions are neglected and multitudes of loopholes are left unguarded, not loopholes alone but windows and doors as well, to give access to the mischief making demon, there is no use in supine fatalism in regard to this question, and it is not good sense to yield to the "nothing can be done" notion until the art of the chemist has been at least tried. I do not think that a manager should assume that he has done his whole duty in the premises until he knows all that the science and art of the chemist can tell him, and I think, were I a buyer of coal, that I should insist on a tender by sample, have this sample assayed, not for sulphur only, but for about 26 other things, and I should insist on the samples being up to grade in all respects; and finally I should insist on the coal being up to the sample. The coal dealers, at least those I have met, will all bear watching. They deserve suspicion quite as much as the much abused gas men, and I know of at least one instance in which I have the best of reasons for saying that a very inferior coal was delivered but not paid for at the high price and in place of the excellent coal which I had examined. In this case an inferior coal was delivered in place of a very high grade sample. It must be a most unsatisfactory place indeed to be in, that of the gas works' manager who buys a coal by the run of the mine. On the strength of the reputation it has obtained from one vein, it may be a mile away from the place from which his present supply comes and even from another horizon, when he finds the raw material very inferior, his coal sheds full of coal, for which his

company has already paid the highest price and his customers dissatisfied with the inferior quality of the gas, into which he must mix a costly enricher to make its grade, when the true cause of all his woes is a gold brick purchased because of another's better fortune. So much for the influence of the coal.

To return to the miniature plant. With it were made experiments leading gradually to the following results, in discussing which I shall speak as if they had been made in a continuous series upon a single piece of coal. In point of fact a number of partial experiments are here assembled, and in the account which follows I am giving, not the account of an experiment written out by the observer as detail after detail is seen, or as if taken down in shorthand as the results gotten are observed, but I am giving the impression concrete in my mind from the careful and systematic comparisons of results from various specimens, yet as far as possible I have isolated the deduction from the supporting premises, and I am very confident that any one hereafter experimenting along the same lines will reach like results.

At the same time I wish to mark one point as a reservation. One conclusion which I reached will be noticed as widely different from that said to have been carried into practice on a large scale, and with huge success by certain gas engineers in England. It is beyond my intention to question their success, or to suggest that they attained it in any other manner than that in which they say they did, but I doubt if using the ordinary coal of daily trial in this country they would have attained any such gratifying results.

In my experiments the retort was sometimes heated very slowly, sometimes very rapidly, but always most carefully, to ascertain for certain if rapidity of heating made any difference in the practical results. When the products of distillation were sent to the condenser directly it was not to be preceived that there was any difference in results, excepting that when the evolution of gas and tar was rapid the rapid rise of temperature which accompanied, or rather caused it, led to the naphthalene going in greater quantity to the gas than it was accustomed to go when the heating was less violent and prolonged. The result of the average slow experiment was to send the tar towards the well with all the naphthalene, while in an average rapid experiment, one with a higher temperature, the naphthalene in some

part would reach the condenser. By means of experiments of this sort, some made slowly, some more rapidly, in which the temperature of the retort was raised as fast as possible, the charge of coal being in every case weighed accurately and in powder which had passed a 10-mesh sieve, it was determined that the amount of the products from a given weight of coal of a given sort was practically a constant, and that the products were as nearly constant in character. It was also determined that the variations, such as it was, was due to the vapors and gases undergoing molecular change under the influence of the hot carbon of the charge, and that by using suitable means to get the gases away from this influence suitable precautions reduced these changes practically to zero. I believe from my experience in these inquiries we are justified in saying that the products of the distillation of any given coal are constant in quantity and quality, if they are not subjected to later and secondary influences, which practically amount to redistillation.

Having satisfied myself of this fact by a preliminary investigation I obtained a relatively large amount of coal, had it ground and sifted; dried for 24 hours by exposure to the air in a steam heated room, and packed in air-tight containers. A sample of this coal was distilled and the fluid and gaseous fractions parted immediately at the mouth of the retort. The gaseous fraction was passed into a condenser with brine at a temperature 2° or 3° below zero, thus taking out the solid and fluid hydrocarbons of low boiling point and passing on the true gases, which went to a holder over mercury, while the fluid portions were trapped at the bottom of the condenser. It may be stated in passing that the condenser through which the tar passed was heated by a superheated solution, thus the tar was kept in a fluid state until it reached the well.

This result was regarded as representing a normal distribution [illegible] both in respect of place and time required for [illegible]. When the temperature of the charge was only just sufficient to attain continuous and complete liberation of all the [illegible] of the coal an exact analysis determined the [illegible] of each ingredient. In this distribution all of the [illegible] and more of the benzol than was expected were [illegible]. In the condenser of the gas system a few [illegible] were found, which came seemingly from the

last few liters of gas which passed through the condensers, but the amount was insignificant. When the retort was heated to the highest useful temperature as rapidly as possible some of the naphthalene was disengaged from the oil and was caught in the condenser tube, but its melting point was not so changed by association with the benzol as by some theories it should have been, for the two parted very early, the naphthalene becoming solid in the tube and the benzol going over into the well. The average of these two sets of experiments was assumed to represent the normal distribution of the products of the distillation of coal, when the products of such distillation are freed at once from the influence of hot carbon and all interaction between the true gases and vapors and the tar is prevented. No doubt my surprise that almost all of the naphthalene should have remained with the tar oils, even when heated above its boiling point, or have been reabsorbed so quickly, will be shared. It cannot be explained, unless we assume that the vapors are also mutual solvents, an hypothesis I do not care to discuss. I only note that the facts are as stated. If this is the normal relation of the distillation products under these conditions, they are certainly very greatly changed by permitting both the gases and vapors to pass in company through a condenser heated to 105° C., under which condition all of the naphthalene and 92 per cent. of the benzol were taken out of the gas by the tar oils, while all the light hydrocarbons and some with boiling points much higher than the temperature of the experiment were carried through the chilled condenser to be taken out in a condenser cooled to 3° C. This seems to me to show a tendency of the two groups, the paraffines and the olefines on the one side and the closing ring compounds on the other, to part company at about 100° C., the temperature of boiling water. This attraction among the individuals or power of mutual solution would tend to explain why the light paraffines do not aid in keeping naphthalene in the gas, when the solvent power of the benzol is satisfied; there being nothing else to hold it the naphthalene must fall. I think this side of the question should be investigated with more attention than is usually given to it.

If, however, instead of passing the distillate through a condenser at 105° C., it is passed through a condenser surrounded by hot xylene as circulating fluid (boiling point 140° C.), the benzol

is all removed from the tar coming out with the gases and vapors, from which all but about 2½ per cent. can be subsequently removed by cooling the gas in a condenser with a circulation at —3° C., while at—15° C. the condenser removes all the benzol. At the same time that the benzol thus escapes the solvent action of the tar oils the naphthalene remains with them, their hold is so much more powerful for naphthalene than that of the benzol. This experiment while interesting in itself is very suggestive of the rational treatment of the naphthalene nuisance in the gas works.

By cautiously raising the temperature of the condenser above 130° C., which can be done by using aniline (boiling point 183° C.) as the circulating fluid instead of xylene, a point less distinctly marked but near to 175° C. is noted, at which a very considerable quantity of naphthalene is present in the gaseous and vaporized portion of the distillate. The inherent interest of this fact is not lessened if the gases and vapors are then led through a series of condensers at lower and lower temperatures, which gradually cool the gas, the gaseous mixture produced by the previous process. For, if the gradient is very steep, so that the gas is at once cooled say to 50° C., the naphthalene is thrown out in crystals almost entirely; but if the gas be very slowly cooled to the same temperature much of the naphthalene remains in it, as if some mutually solvent action were now exerted between it and the benzol.

In a number of instances the naphthalene remains in the gas until the temperature fell to the minimum, being deposited gradually little by little all the way through the tubes, but at other times, after having been carried down a descending gradient from 30° C. to 15° C., without any coming out, the entire naphthalene content would come down suddenly, so that it seemed to "fall like snow flakes" and blocked the pipes.

We may be content with this knowledge of the relations of the groups and say that ordinary coal gas, as made by the processes in vogue before higher temperatures were made needful by the demands for greater yields and brighter flames, corresponded with the analysis by Bunsen; that his assertions in regard to the typical contents of any given illuminating gas were quite correct, however much the present methods and analysis may differ from his methods and results, and that his conclusion that benzol was the highest of the hydrocarbon molecules which had to be

considered was true at that day; but he would not be justified in saying it to-day, and we as certainly know that we are not justified in so doing, even if we substitute the word "illuminants" in our reports to cover up our concealment, that we have not determined either the identity or the percentages of the members of this uncertain group, especially if examining a gas, in which the naphthalene having remained in the tar but partially, benzol and "the illuminants" are no longer interchangeable terms.

At this state of the inquiry it may be well to consider for a few moments the facts in relation to the solution of the naphthalene by the tar. While it is now generally believed that the true solvent is the anthracene oil, quite a respectable minority seems inclined to say that the isomeric oil, phenanthracene, or phenanthrene, is the real dissolving agent, since these are both present in all tars, but in various proportions; others affirm that the solution of anthracene in phenanthrene is the one essential condition. It is not worth while to enter into a discussion of this particular point, important as it is, until some one has been able to experiment exhaustively on both with a plant so built that they may be used either together or apart and their relations fully noted. It is enough for the present to say that both anthracene and phenanthrene are present in the tar which dissolves and holds the naphthalene.

It is also coming to be held as a pious opinion by not a few, and by the men most familiar with the chemistry of the question, that the cause of the naphthalene nuisance is to be found in the fact that the products of distillation remain for a long time, relatively a very long time, in contact with the retort walls, and that the walls and the most part of the charge are so hot that the "heavy oil," which used to dissolve the gas-contained naphthalene, is broken up. That by this "cracking process" valuable illuminants are formed is denied by none; but at the same time naphthalene is also formed, and that the amount of naphthalene left by the combination and manufacture is beyond the measure which the small amount of the oil which escapes the cracking process can take up seems to be a manifest fact. From these premises they draw the conclusion that the naphthalene nuisance is a direct product of the scheme of temperature management now in vogue. Of course, this is denied by the partisans of the high (very high) temperature theory, among which are a

few who deny the very fact of the solvent action of the oils, while others deny their destruction by the excessive temperatures.

These questions are obviously vital to the matter in hand, nor do I see how they can be worked out until some rational way is found for regulating temperatures. An admirable little appliance for ascertaining the temperature within certain limits was invented some few years ago in Philadelphia, but it certainly is not in common use. In fact every man is isolated from his fellows' experience by the fact that if A does not know how hot his retort was when a certain phenomenon happened, how then shall he try to make his experience useful to B?

To one used to working with apparatus by which the heat of a furnace can be recorded, no matter how conventional the scale, the condition of the gas works' manager seems like that of a seaman navigating without a compass. It is not of any use to attempt to narrate my experiments on this part of the subject, although it is the most important part, in any fullness simply because there is no means at my command of bringing before you relatively small differences in the temperature of the retorts. Thinking that I might get some clever suggestion, as I have time and again from a question box, I asked this from one of the State Associations, and got two peculiar answers, two questions having been asked. To my question, how hot the retorts were to be, I received as reply, "1,800°, or a bright cherry red, was considered the limit of temperature," but the information of the scale on which the 1,800° was reckoned was not given, nor any clear intimation as to the light, for no two men see color alike, nor do colors seem the same to the same man twice. To my other question I received the answer, "no one was using a pyrometer." Under these conditions it is useless to give details and I simply state my conclusions. My attempt seems to have brought out one fact—that concensus as to the cause of naphthalene formation—which was said to be "too high temperature in the retorts," and "too light charge."

My own experiments incline me to the conclusion that the naphthalene problem looks like one of those signs which change their reading with a change in the point of view, and that amidst the conflict of evidence there is a statement of fact, overclouded by large fancy, however.

If the true gases and the whole of the vapors obtainable from

the coal are carried through the secondary furnace, which I have described, and for convenience shall call "the superheater," a long iron tube filled with small pieces of coke and heated very hot indeed by a specially constructed gas furnace, great changes are produced in the gas. The oils are more or less destroyed, the absolute amount of destruction being uncertain. The amount of "pitch" is relatively much increased, the naphthalene content is augmented largely, and apparently the amount of the increase in the naphthalene had a definite relation to the amount of oil destroyed.

It was also apparent that the decompositions followed the lines which have been repeatedly suggested by writers of scientific papers on the structural composition and decomposition of hydrocarbon gas and vapors.

Thus the benzol content is seemingly increased from one-half to two-thirds, but in cases in which the decomposition seems to have influenced the anthracene rather than the phananthrene, and there are such, acetylene molecules are distinguished; but in the more usual experience the miscellaneous free molecules unite to form more stable unions after the pattern of the benzol ring rather than after the shape of the paraffine changes.

That is to say that the "acetylene bond" between the two benzol rings in the anthracene and phenanthrene has broken away, that three of these acetylene molecules have united forming benzol, which is at first very much increased. The two benzol rings thus freed at times seem to take up hydrogen completing their form, sometimes uniting with other substances developing side chains and in a multitude of ways making the unexpected substances which are all the time turning up in small quantities in the gas, but, if the action is sufficiently prolonged and the temperature sufficiently high, always ending in the formation of naphthalene. This naphthalene, of course, like everything else, comes from the superheater in the state of vapor, but it is no longer in the grasp of the anthracene oil. Even that portion of the oil which remains has for the time being lost its grip, and as the vapors are cooled the precipitated naphthalene comes down anywhere and everywhere, but chiefly where it is not wanted. Just as in practical working in the retorts of the gas house, so also here, a portion of the naphthalene seems to have come into the control of the mass of benzol molecules, to have been dissolved

in, and to remain in solution in, the benzol vapor, as it were in permanent mechanical union with it, so to remain unless frozen out later on, or to be washed out with special apparatus.

Just so it is in the apparatus of the gas works and the street mains. In these, even in midwinter, some of the naphthalene remains in the grip of the benzol and the light oils and only comes down under conditions which make the precipitation which I have mentioned as occurring in my experiments simply inevitable, and then the vicious circle is complete, the nuisance is fully established, every condition for producing it is called into being, and to crown the work, all these vicious conditions are made self-perpetuating.

To remedy the naphthalene nuisance it was needed, first, to show the cause. This I have endeavored to do, so far as laboratory experiments could go, and I am sure that everyone of you as I have been speaking has been calling to his mind and memory facts from his own experience, which facts now make him willing to accept the offered proof of the thesis, which I propose as logical and as final. Having set before you the cause of the naphthalene nuisance, the opportunity is now given to me to suggest to you something of the remedy.

Permit me, first of all, to point out to you that two phases of the naphthalene problem exist. In one the amount of the absorbent oils is sufficient for taking up the naphthalene, but owing to various circumstances the oil cannot act. In the second case the absolute amount of oil is wanting, even if ample opportunity for action were permitted to it. This distinction is vital, and on it I was forced to found two distinct lines of experimentation. I am able to say that I have worked out the mechanics, both material and dynamic, of both of them and have constructed laboratory apparatus answering to both which under laboratory conditions did perfect work.

I shall lay before you all the facts and so much of the theory as seems needful for a full understanding of the solution of the question, and having done so shall leave the matter for treatment in stone and iron to the practical men.

When the oils and gas come from the retort both alike are vapor, but the oils quickly condense owing to their high boiling point, and are parted at once from the gaseous fraction by this simple fact. Custom dictated that they should be separated

from the gas as soon as possible lest they should take up the benzol. As often happens, custom has survived under other conditions than those which justified its foundation. This parting of the oils and gas is as it should be. The oils, all of them, and the whole of them (if so be there is enough for the task they have to do, then the works and their manager are indeed fortunate) should be taken out of the gas at the earliest possible moment; but they should be returned to it again in a specially designed way, in a specially designed scrubber to take out the naphthalene.

My experiments seem to show that the oil should be passed into an apparatus designed to expose the largest possible surface of the oil to the gas containing the naphthalene. When it enters this washer it should be at a temperature somewhat above the point at which naphthalene becomes solid and begins to fall from the gas. As the oil flows down through the scrubber it is gradually saturated with the naphthalene vapor; consequently, when it enters the apparatus, the oil which is naphthalene free meets a gas which contains but very little naphthalene, and both are at a temperature which leads the oil at once to dissolve any naphthalene it meets, absorbing naphthalene as it flows and, at the same time, rising in temperature, the power of absorption is decreasing, but much less rapidly than the lessening of the absorbability of the naphthalene, so that the rate of absorption runs rapidly to a minimum. Please to note that the direction of the flow of the oil is from *B* towards *A*, while at the same time the gas is flowing in contrary direction, from *A* towards *B*. The gas is constantly growing cooler and the oil warmer, and when the oil has reached a certain temperature the pump removes it nearly saturated with naphthalene to a suitable well for storage. Some one will object and say: "How about the benzol; is not that absorbed by the oil?" Of course it is; but since the oil can absorb only just so much, it can only take up a certain percentage; and since the oil lets go the benzol rapidly as it rises in temperature, the oil will have given up all the benzol which it has absorbed by the time it is pumped into the well. The effect is to keep the gas nearly saturated with benzol between the point at which the oil leaves the gas in the scrubber and the point at which the oil enters, although the amount taken up by the oil is not great, because naphthalene becomes solid at 80° C. and a vapor at 218° C.; between these two it is absorbable as a fluid.

The oils which will be used will have a temperature of about the same height as the boiling point of the naphthalene, just a little less so that they may be said to be of the same temperature, and the oil saturates rapidly. At these temperatures benzol is a vapor under tension, a gas; and to fear disaster to our plans by reason of the absorption in any quantity of benzol is to be afraid of our own imaginations. In some of my experiments I did have trouble of this sort, because I used an oil with too low a boiling point, cooling the naphthalene more than was either needful or wise. For this reason I do not think so well of this plan as of another which I shall describe in a few moments.

The steps of this plan—Plan A, if you please—may be put in order as follows: Step 1. Withdraw the oils from the gases at once. Step 2. Cool the oils to about 215° C. and pass them back into contact with the gas in a scrubber, as Step 3. The result will be the almost complete removal of the naphthalene. Some minor details must be attended to, but such are the bold outlines. The final disposal of the oil must rest with the needs of each case.

It chances that a very like plan was devised by an English engineer, and described in the Journal of Gas Lighting in an account of a meeting of a Society of Engineers. The number of the Journal is that for November 11, 1902, and the joint authors of the paper are Messrs. Thos. Glover and Wm. Young.

In abstract the paper was much as follows; but while this paper gives an illustration of the development of a phase of the general scheme which I have just sketched and is quoted as such, its chemistry is its own. Words are used with a certain inaccuracy which might easily cause the reader to be misled concerning matters of fact; as, for example, concerning the origin of naphthalene in gas, and there are not a few statements whose logically necessary consequences must either have been unknown to, or ignored by, the writers—one cannot imagine the former of the propositions of this dilemma.

It seems an obligation to remind you that I am quoting this statement of their theory to explain their practice, not because it meets my conception of the facts. Had their study of the theory of naphthalene formation, their chemistry, if you will to call it so, been as competent as their perception of the trouble, considered simply as a mechanical difficulty from which they wished to

escape, their contribution to the literature of the subject would have been as important as is their contribution to the practice of gas purification. And this practical application of the notion of washing out the naphthalene at a definite place would in its turn have lost nothing of its value; indeed it might have gained in importance.

In the number of the Journal referred to the paper is given in full, and also the discussion which followed, and I advise its reading by every gas works' manager. My quotation is verbally accurate, but in a few places I have compressed some sentences and have transposed others to emphasize their premises and deductions. The paper reads: "The altered conditions account for the increased troubles from the presence of naphthalene, the naphthalene being produced in larger quantities and there being a diminished production of the solvent tars to take it up into solution. And, further, the hydrocarbon vapors with a higher tension than naphthalene being smaller, the increased volume of gas is less saturated by them, and the gas is in consequence capable of taking up, and retaining in diffusion during the process of condensation, an increased quantity of naphthalene. Or, to state it another way, the volume of gas and the proportionately smaller volume of the volatile vapors (these being mainly the vapor of benzol) and the smaller production of the solvent tars, places, so to speak, a wider gap between the saturation point of the gas and the tars. That is to say, that if the gas were brought into contact with a tar containing a large percentage of hydrocarbon vapors such as benzol, the unsaturated gas would take up in (by) diffusion a portion of such benzol vapors; and on the other hand if the tar were brought into intimate contact with gas more highly charged with benzol vapors the tar would dissolve out of the gas a part of such vapors." It is very difficult to determine how much of these sentences is to be looked upon as hypothesis and how much as demonstrated fact, but the following, which in the paper precedes that just quoted, is less ambiguous—has the form of an observation, but it is not stated to be so. The sentence reads, "With high temperatures a considerable proportion of the vapors, which under lower temperatures would ultimately condense as tar, are cracked up, mainly into permanent gases as carbonic oxide, hydrogen or (and) marsh gas, and into the stable hydrocarbons as naphthalene and benzol. The permanent

gases are, therefore, much larger in volume and are capable of taking up and holding in diffusion a large volume of vapor. The denser tars are smaller in quantity and, therefore, less able to dissolve out of the gas the vapors of the hydrocarbons diffused through it. Not only so, but the natures of the hydrocarbon vapors predominating in the gas have been changed in character; being converted into naphthalene and the very volatile benzol, those of medium vapor tension being present in comparatively trifling quantities."

I confess my inability to understand these two series of statements, for it seems to me that hypothesis, observation and deduction are so intermingled that I am not able to rightly assort them, but if they represent observations, or logical deductions from observation, then I do not see how there can be any naphthalene problem, for it is only by closest study after the naphthalene problem has been practically eliminated, has been eliminated in practice, that such a theory of the action of the contained elements could be studied in detail. Yet my stricture which is not criticism, may be unfounded because the authors are dealing with a special coal, which may contain an assay of hydrocarbons as dissimilar to those of American coals of the same generic type, as are the cannel-like lignites and the "Coals of the Henry mountain region" to those of the Provo Valley or Ceder City levels in Utah. All are gas coals, and by some men are classed together under the name of "bituminous lignites," but they differ among themselves as much as Baku petroleum, the shale oil of the British Islands and Pennsylvania "coal oil." It suffices that the deductions or observations, be they which they may, do not apply to any coals which I have been able to examine. But however much one may question, and wish to study and discuss the chemical theories of the Glover-Young paper, there is no call for questioning the success of the Glover-Young process. The statements in chemistry may be confused in theory, the engineering practice shines as the sun.

The paper contains a resume of the process as follows:

"The process consists in collecting the denser tars from the gases while they are still warm, and holding in diffusion a considerable proportion of the high tension carbon vapors capable of being removed from the gas by condensation and solution. This is accomplished by collecting the tars deposited in the foul main

while still hot, and fixing in any convenient position upon the foul gas main a tar extractor or separator, by which the liquified particles suspended in the gas may be precipitated and collected. The tars are passed to a cooling and settling tank, whence (having parted with the ammoniacal liquor), the cooled tar is passed into a combined condensing and washing arrangement of any convenient form, by which the tars can be brought into intimate contact with the gas, the hot gas and the cooled tar being made to flow in opposite directions. The cooled tars having been removed from the gas while warm are comparatively free from naphthalene and possess practically the full solvent power. Also, being thus applied fractionally by being passed in among the cooled gas, and flowing back against the advancing current—they will, for well understood reasons, exercise the maximum cooling and washing effect, besides carrying away the naphthalene *as it is deposited.* [Please note this, "As it is deposited;" they do not say as fluid or as solid.] The tar being gradually heated, as it flows back against the current of the warm gas, gives up the more volatile of the hydrocarbons, which they have absorbed in the cold end of the condenser washer, while the temperature is not sufficiently high to cause the revolatilization of the absorbed naphthalene. The tars would thus not only be employed to exercise their maximum solvent power for the naphthalene, but they would in turn be subjected to a distilling process to recover and retain in the gas the more volatile vapors."

Such is the description of the theory and practice of this process and its application, as set forth by its inventors after full opportunities for study of its practical application. To fully understand the process of reasoning by which the theory arrived at its present development requires a careful study of the paper, and the making of experiments with the identical sort of coal which they used. In the paper are given certain figures which might be of interest here. I am unable to compare them with corresponding American figures as such data were unobtainable from those to whose interest in the matter I appealed for information, and, therefore, I omit them since to give them alone would, I am sure, cause still more confusion rather than advance our enlightenment.

The second phase of this theory of removal requires a place of election for using the process and a choice in an absorbent for

the naphthalene. There are a number of forms, phases is perhaps a better word, of this practice before the gas world. Some are simply "propositions," perhaps the majority have not passed beyond this stage, a few have run the gauntlet of the patent office, some very successfully, but it is a trial in which from what I hear I judge the larger part has come to grief. A few (they can be counted off on the fingers) have been translated into stone and iron. How successfully they are working I dare not attempt to say, judging by a prospectus or two which I have seen. Someone thinks that all promise well, a few promise better, and perhaps three really work.

Taken as a group the really effective machines seem to justify some such proposition as this, viz: Owing to the uncertainty in amount and composition of the residual oils, it is a matter of economy to disregard any naphthalene absorption power which may be inherent in them—these residual oils that is, and to introduce at a point of election a supply of specially selected oil, of oil chosen for its value as a naphthalene absorbent and for this only, and to make use of this especially selected oil thus introduced instead of in any way or to any degree trusting to the thus abandoned residual oil.

How completely antithetical are the English scheme, that of Messrs. Glover and Young, as represented by their description in the quoted paper, and that of the German patents as given above, if I have correctly summarized the group, goes without saying. The fact that the proper agent for absorption is the heavy oil with a high boiling point commonly known as "anthracene oil," and sometimes spoken of or written of as "green oil," seems to be generally admitted; but how best to apply this oil seems as yet undetermined. How best to use it seems to be the end of all effort for most of the processes which I have studied, and it seems to me evident that not a single one of the inventors of these various processes had any precise working theory before his mind. The existence of a working theory of some sort seems almost a necessity, yet if it really exists the machines are so constructed that it is not apparent. When chemists are constructing a plan from which to design some machine, for accomplishing some desired object, they first determine the scheme of the chemical reactions, then raise the question of what is called the temperature scheme, and it is certain that every detail of the plan will be

worked out before it is made even discussible as a design on paper for constructing engineers to consider; much will it be then discussed before it is made tangible, before it is translated into bricks and mortar, into brass and iron. This question of the new gas making is distinctly a chemical process, or rather a chemical industry of many independent processes, among which the process of getting the naphthalene nuisance under perfect control is by no means the least important, and in this process of naphthalene control one of the most important; yes, the most important item of them all, is the scheme of the working temperatures, the system of the temperature gradients to use the technical vocabulary. These important temperatures from an ascent in a regular order, beginning with the boiling point of benzene thus, the pressure being thus:

Benzene, freezing point			boiling point	(79° C.)
Naphthalene	"	[80° C.]	"	(218° C.)
Anthracene	"	[213° C.]	"	(351° C.)
Phenanthrene	"	[103° C.]	"	(340° C.)

Bringing the gas under control, so that we secure the condensation and complete separation of these two last mentioned as the first step, we part them from the naphthalene and benzene while these are under such high tension, due wholly to temperature, that they react exactly as if they were true gases, and by this complete and rapid separation we prevent the formation of relatively confused mixtures and solutions of the vapors of these "heavy oils."

It should never be forgotten that the figures above given are for the pure or nearly pure substances, and they must be modified in order to adapt the oils to the duty we need them for. For the moment we simply wish to remove them with anything else condensible, which we do by rapidly cooling the vapors to 300° C., as nearly as may be. In the laboratory this is done by filling the condenser with the pure phenanthrene oil, which can, of course, not be heated hotter than its own boiling point, and in fact is usually some degrees cooler.

Please to note, then, that this first condensation removes the "heavy oils," so-called, in a nearly pure state, ready for any use we may see fit to make of them hereafter. Objections have been made to this process by a number of men—curiously enough the

men were of the class commonly called "practical"—but the objections were and are wholly of the kind called "academic," or, to use the nomenclature of the practical men the objections were, to the very last one, "theoretical objections."

My reason for advocating the removal of these components at the earliest possible minute, and their complete removal, agrees with the German rather than the English theory; but, when removed thus early, they leave behind them a mixture which it is possible to consider constant; and if allowed to remain in contact until cooled to a lower degree, say to 250° C., this constant or practically constant composition. a most important and valuable characteristic, is quite lost. I have made experiments in both ways of treating the gas and all my results favor complete and early removal. The gas having been passed downward through this condenser to collect the heavy oils is now passed through a horizontal condenser to "freeze out the naphthalene."

That is to say, the vapor of the naphthalene, benzene and other condensible hydrocarbons is rapidly cooled to near 200° C. At this point we have a "naphthalene fog." The glass tube of the condenser is obviously wet with the fluid naphthalene and a beam of light shows that the tube is filled with naphthalene, condensed as a fog is, but not falling as rain nor frozen. The practical question is, shall we rapidly remove this by a centrifugal condenser, or shall we do so by cooling the gas to the freezing point of naphthalene; *i. e.*, to 80° C.

Bear in mind this important fact, at 80° C. naphthalene is solid and benzene is a gas, but in the presence of a mutual solvent, such as ethylene for instance, and specially if acetylene is present in no matter how small a quantity—as little as one part in 100 of the naphthalene has in more instances than one proved sufficient in my experiments—an amount of the naphthalene amounting to many per cent. will remain which cannot be frozen out. But while the benzene will dissolve, and thus prevent the solidification of a portion of the naphthalene, the solidified naphthalene will not occlude the benzene. At least I have never been able to effect such occlusion, nor do I find the record of such occlusion as made certain by the experiments of any other chemist.

Therefore, in this scheme of purification, the next step is to cool the gases and vapors, not to 218° C. but to about 70° C. By

so doing all the naphthalene not held in solution by the benzol and ethylene is literally frozen out. It may be objected that the amount of naphthalene which can be made solid by cooling to 50° C. or 40° C., or even to 30° C., is so much greater that such solidification may take place some time in the future. This I am inclined to question for two reasons: First, because consecutive cooling of the gas, when it had been treated as suggested previously to the cooling, failed to bring down any deposit of naphthalene; secondly, because the solvent power of the benzol ethylene solution for naphthalene seemed rather to increase than to diminish with declining temperatures to 30° C. I made no experiments at temperatures below this one 30° C. for lack of time, but at this temperature the solvent power of the benzene-ethylene mixture seemed to be greater than at 80° C.

Assuming that one wished to remove the last vestiges of naphthalene and leave the gas so to say naphthalene free, it can be done by washing with the common "anthracene oil" of commerce which has been prepared for the purpose; or if the supply of heavy oils which have been saved is sufficient, they may be used.

These oils must be prepared for the purpose by getting into solution in them a certain precentage of benzol. Not as has been represented, to saturate them with benzol and thus prevent them from taking up any more, but in order that they may have a sufficient fluidity at the temperature at which we wish to use them.

Having obtained by judicious mixture an oil which has a fluidity at 70° C. to flow over and adhere to the surfaces which we may elect to use for constructing the absorbent apparatus, we permit it thus to flow, preferably from above downward, and cause it to come in contact with the gas containing the residual naphthalene. This the oil will remove, leaving the gas quite naphthalene free, but removing in the process nearly the whole of the benzene content. The gas thus treated requires enrichment; the benzol thus removed should be replaced for the sake of luminosity, and this can be done later after the gas has gone through such processes as are needed for its technical purification.

I would not have you misjudge me so far as to think that I fail to appreciate how much must be done, and in how many

directions improvements must be made before any such simple means as this which I have sketched can be made practically useful. I appreciate them—yes, appreciate them fully; but the changes required are not great changes in bricks and mortar, they are not changes in the physical structure of the works to any great extent. One engineer with whom I discussed them said that the changes I proposed in plan and structure all tended towards simplicity and unity rather than towards complicating the present plans, but he raised an objection which he seemed to think insurmountable, "You will find that you cannot get *the men* you need to put in operation a system depending for its success on a careful attention to trifling details." He continued his criticism thus: "While the men have intelligence enough I doubt their good faith. When you are watching them it will be all right, but when your back is turned the inevitable disposition (they all think it) to get the better of or beat the boss, will make confusion in a system so nicely adjusted as this which you propose must be."

I am loath indeed to think that a system of naphthalene purification which works so well, so all but automatically among the glass and porcelain of the laboratory, will not work among the bricks and iron of the gas works; but even if it is so today it may not be so always. The future has been discounted many times before and has cashed the draft when it came due.

One thing more I think I should say before I bring this paper to its close. I have examined the materials concerned in many naphthalene stoppages—some dozens; yes, some scores—and I have yet to find the first one which was made by naphthalene unaided. When the material obtained from the occluded pipes was cautiously distilled there always without exception appeared a tiny drop of heavy oil whose boiling point plainly showed that it was a mixture of the two highly complex oils which have been so often mentioned in this paper as anthracene and phenanthrene. The amount in any given case was too small to determine surely the precentages of the two in the mixture, but by collecting the residue from about two dozen stoppages, I obtained enough to assert provisionally that the anthracene was in the cases referred to about one-third and phenanthrene about two-thirds. It seems to me that this is a demonstrative proof of the importance not only of getting rid of all superfluity of naphthalene, but also of

getting rid of that little drop of oil which forms the nucleus about which is built the structure, at first amorphous, and after some time crystalline, which we may call typical of the naphthalene nuisance. As if to impress upon our minds the importance of this fact let me quote a few lines from a letter I received a few weeks ago.

"Do you know that I am much interested in two statements in your letter. First, that naphthalene stoppings have a nucleus not naphthalene; and, second, an experience which agrees with my own, that the most troubles with naphthalene stoppings do not come in the coldest weather? Can it be that oil fog, so fine that we cannot perceive it, sometimes carries heavy oil; because this vapor dissolves more readily when the gas is not well cooled?"

Let us think about this component of the plugs, the tiny drop of oil, and study how large a part this plays in the naphthalene nuisance; such thoughts may be useful some day. We now know how to get rid of the plague and can study the cause at our leisure.

Now, gentlemen, my time is up. I have tried to follow out the scheme suggested to me by your President. I trust that I have succeeded at least this far, that you feel that the time spent in listening to me was not lost. If I shall have succeeded in indicating the lines of least resistance on which we can most successfully do battle with this naphthalene nuisance my purpose will have been accomplished.

On motion of Mr. D. McDonald, a vote of thanks was tendered to Dr. Birchmore for his lecture. On motion, the Association adjourned to reassemble at 2 o'clock, P. M.

SECOND DAY—AFTERNOON SESSION.

The President called the Association to order at 2:30 P. M.

A COMMENT ON THE BIRCHMORE LECTURE.

MR. W. E. STEINWEDELL—I would like to say a word or two respecting the lecture by Dr. Birchmore. I have made a few notes on it. The Doctor certainly treated the naphthalene topic

from a chemical and experimental stand point with great thoroughness, and his presentation will certainly be appreciated by the gas fraternity; but a word might be added regarding the removal of naphthalene from gas as practiced in about 40 works of Europe to-day. Heavy coal tar oil to which 3 per cent. benzol is added absorbs naphthalene until it contains from 15 to 40 per cent. of naphthalene by weight. A small Standard washer, having two chambers, is best used for washing the gas with this oil. The second chamber is filled with fresh oil, and the first with oil from the second chamber, as that in the first becomes saturated. The saturated oil can be run into the tar well where it will thin the tar somewhat, and be sold as tar. Figuring the reagents only, this method of removing naphthalene costs, according to European selling prices, about 0.38 cent per 1,000 cubic feet of gas, but deducting the value of the tar recovered, makes the net cost 0.07 cent per 1,000. Naphthalene is removed after the heavy tar has been separated from the gas, as after the P. and A. condenser, for as the gas is cooled in the washing and scrubbing apparatus, without the previous extraction of naphthalene, the latter is deposited and produces stoppages in the apparatus and in the connecting pipes of the works, as well as in the distribution system of the city. In small works operating without tar extractor the oil can be run through an apparatus similar to a scrubber which will act as a tar extractor as well as a naphthalene washer. Ordinarily about ½ pound of oil is necessary per 1,000 cubic feet of gas. In washing naphthalene from gas the oil is used until saturated. In order to determine this point it is necessary to test the oil at regular intervals, as follows: Place 100 c. c. of the used oil in a boiling flask connected with a Liebig condenser provided with a thermometer. Heat gradually and allow the condensed vapors to flow into a graduated cylinder. The naphthalene comes over between 200° to 270° C., and is caught in a separate cylinder from which the percentage of naphthalene in the oil, as well as the degree of saturation, can be read directly. Naphthalene has also been successfully removed from gas by passing the gas through a purifier filled with sawdust, wet with an alcoholic solution of picric acid. The cost, however, was too great for practice. The careful, concise and progressive manner in which the author has handled his subject is

most gratifying and is deserving of the sincere thanks of this Association for the pleasure and instruction afforded.

The President called for the

REPORT OF COMMITTEE ON GASHOLDER SPECIFICATIONS,

which was read by the Chairman (Mr. H. A. Carpenter) as follows:

To the President and Members of the Western Gas Association:

The members of your Committee appointed "To prepare standard and uniform specifications for gas holders of the medium and small sizes, in view of eliminating irregularity and assisting managers of smaller plants in checking up gas holder bids," were loath to accept the responsibility, appreciating as they did in some measure the difficulties in the road of success in this direction. However, they did not feel like refusing to serve, as they are believers in the thought that each member should do what he is appointed to do in an institution of this sort, and accordingly accepted the work, hoping to produce something which would be of value to the Association.

The further we got in the matter the more difficult the task appeared, and after much thought and planning, including a consultation with your President, we have decided that it would be unwise for this Association to go into the details of this subject. The various holder builders have spent years in developing their particular type of construction and would not favor any standard specification which might perhaps eliminate some of their special features. Therefore, it seems best in submitting this report to simply lay emphasis on general desirable requirements which could be applied alike to all designs of holders.

There has been much written and said in this connection. We will simply enumerate some of the points again:

It is desirable to limit maximum strain in tension to 13,500 pounds per square inch of least section of metal involved; this may be applied to every part of the structure, tank, holder and guide frame. In the light sheets of the holder shells and crown nothing should be lighter than No. 12 B. W. G., and it is even desirable to make these sheets No. 10 B. W. G.

All cup and grip sheets, as well as top and bottom courses of the holder shells, should be at least ¼-inch material.

A good, safe specification for steel plates or shapes would be of basic open hearth steel, of an ultimate tensile strength of from 52,000 to 62,000 pounds per square inch, an elastic limit of at least one-half the ultimate tensile strength, and to stand bending test cold flat on itself without fracture on outside of bent portion.

Particular attention should be paid to the original coat of paint. Use a material which can be easily applied and spend sufficient labor to spread it well on the surface.

Respectfully submitted,

H. A. CARPENTER,
W. A. BAEHR,
A. J. STACEY,
Committee.

THE PRESIDENT—I think the report states pretty clearly the object of this Committee to see if some conclusion could not be reached by which different sizes and designs might be eliminated; but, as you see, the work was not pleasing.

On motion of Mr. Miller, the report was received and the Committee discharged with the thanks of the Association.

The President called for the

REPORT OF THE COMMITTEE ON MEMORIALS

which was read by Mr. Thos. D. Miller, as follows:

During the past year the Association has lost two of its active members, Mr. E. H. Jenkins and Mr. Julius Buss.

Mr. Jenkins embarked in the gas business while still a boy, his first service being with the Indianapolis Gas Company. His advance was rapid and every change brought promotion. He was identified with the gas business at Indianapolis and Elkhart, Ind.; Cedar Rapids, Minn.; Columbus, Ga.; Covington, Ky.; Buffalo, N. Y., and San Antonio, Tex. At the time of his death he was President of the San Antonio gas, electric light and street railway properties. Notwithstanding his residence in the city and State covered only a short period, at the time of his death he was one of the best known and best liked men in the city. Progressive and energetic, he was quickly identified with the

interests of the city and State. He was a Past President of this Association, and at the time of his death was President of the Southwestern Gas, Electric and Street Railway Association.

He was well known to us all, and was loved for his genial and energetic characteristics. We can ill afford to lose such a man. The members of the Association desire to express their deepest sympathy with his wife and daughter.

Mr. Julius Buss received his education as an engineer at Dortmund, Germany, his native town. He was an engineer in the Imperial German Navy, and afterwards engaged as an engineer for August Kloenne, of Dortmund, in which capacity he served for a number of years, and then came to this country where he was engaged as an engineer by Mr. Fred. Bredel, of Milwaukee, for the past 14 years. He died at the home of his mother in Dortmund, this being his last wish, and he left Milwaukee only a month before his demise.

He was physically, mentally and socially a big man, and his hearty good fellowship will long be missed by those who knew him and appreciated his many sterling qualities.

It is fitting and proper that this Association should express its profound regret at the loss of such a member, and we desire to extend our sympathy to his mother in her bereavement.

THOS. D. MILLER,
WM. MCDONALD,
FRED. BREDEL,
Committee.

On motion of Mr. Fitzgerald, by unanimous standing vote, the report of the Committee was received, adopted and ordered spread upon the minutes.

ELECTED TO HONORARY MEMBERSHIP.

THE PRESIDENT—The name of a very prominent member of the fraternity, who is known to many of you, has been presented to the Board of Directors as proper for election to honorary membership in this Association. The Directors consider it fitting and meet that such compliment be paid this gentleman—Mr. Thomas J. Cunningham, senior editor of the American Gas Light Journal. The recommendation is placed before the Association for action.

CAPT. WHITE—I move that the recommendation submitted to us be concurred in, and that Mr. Thomas J. Cunningham be placed on the roll of honorary membership.

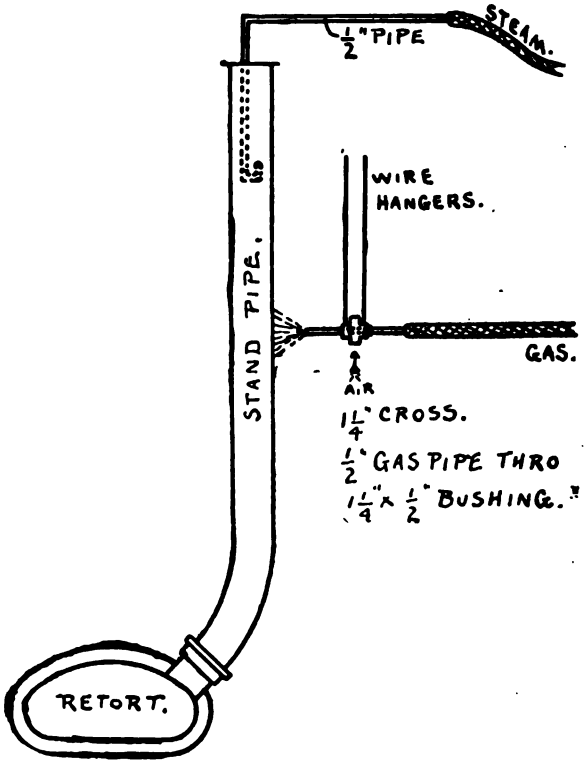
The motion being put to a rising vote, was unanimously carried.

The President then introduced Mr. W. E. Steinwedell, of Cleveland, O., who, as Editor of the

WRINKLE DEPARTMENT,

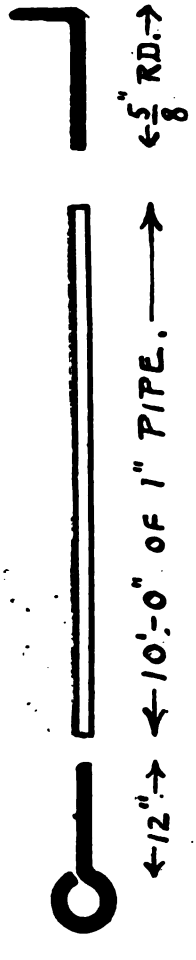
presented the following budget:

No. 1—*Cleaning Choked Standpipes.*—Mr. E. C. White, of Long Branch, N. J., sends No. 1, the illustration showing a gas burner for heating standpipes to melt pitch. This burner, made from a 1¼-inch cross, and having gas supplied from the



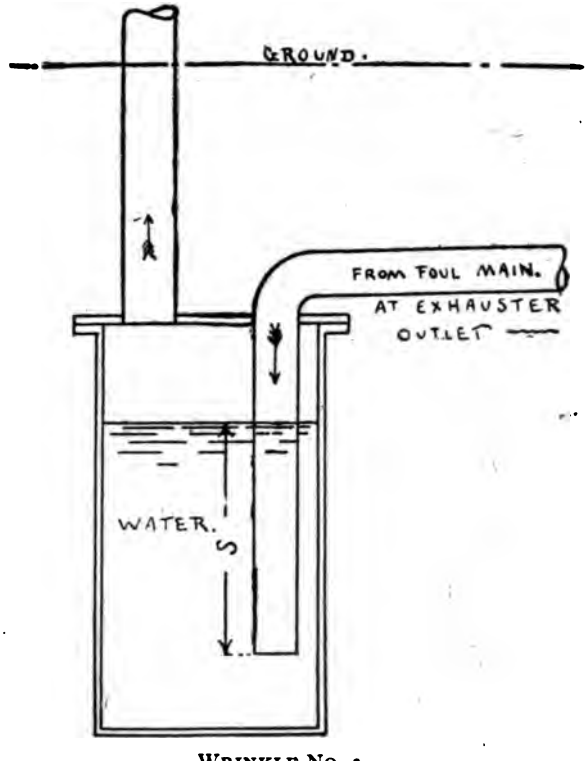
WRINKLE NO. 1.

exhauster outlet where the pressure is highest, was applied to a "bad sticker," in which no auger would produce an opening. After applying the heat for an hour the pitch began to run down, and there was then no trouble in running the auger through from the top and thoroughly cleaning the standpipe. Another good method is to get a small hole through the pitch with a long bar from above, build a wood fire at the mouth of the retort and insert a steam pipe from above, as shown in Fig. No. 1. The pipe is turned up at the bottom, so that when steam is turned on an upward draft is created in the standpipe, drawing the flame and hot air from the wood up through the pitch, causing it to quickly ignite and burn.



WRINKLE NO. 2.

No. 2.—*Coke Rake.*—Fig. No. 2 is from Mr. J. H. Enright, of Carthage, Mo., who describes this rake as follows:

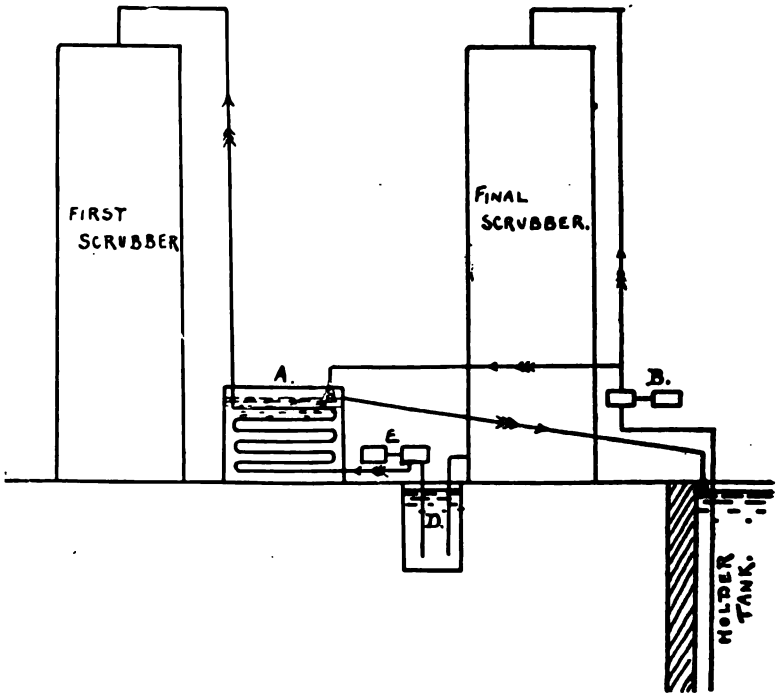


WRINKLE NO. 3.

It is made from 10 feet of 1-inch black pipe, which has the handle of the old rake, cut off one foot from the end, welded into it. A piece of $\frac{5}{8}$-inch round iron, 3 feet long, is then bent into a proper hook, passed into the other end of the pipe about a foot and welded securely.

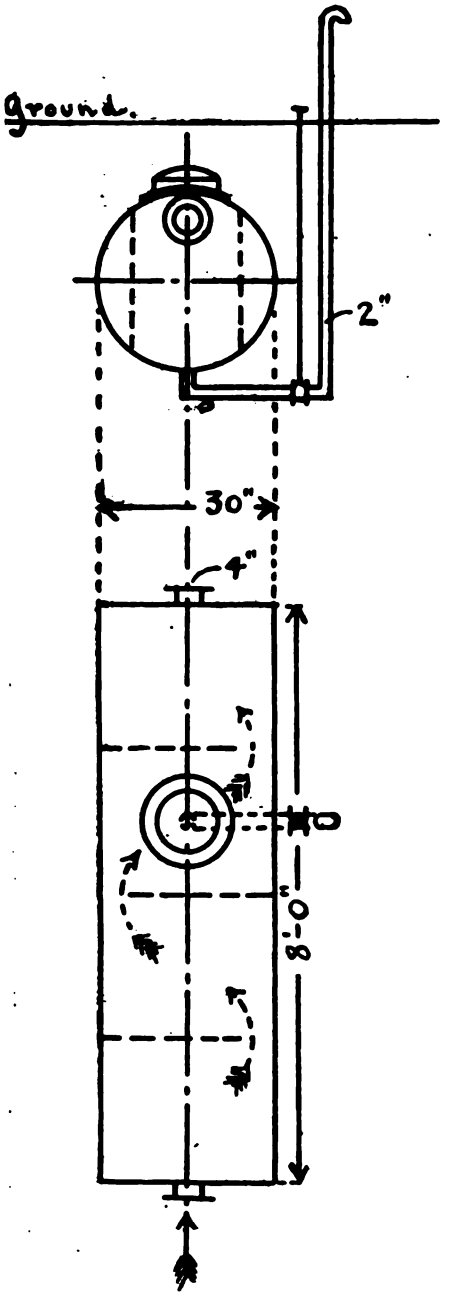
This rake is lighter, does not become heated as quickly, and lasts 3 times as long as does the old-fashioned rake.

No. 3.—*Gas Safety Seal.*—To avoid the possibility of gas escaping in any part of the buildings of gas works, on account of high pressure due to naphthalene or other stoppages, Mr. J. A. Mayers, of New York City, suggests the apparatus shown in Fig. No. 3.



WRINKLE NO. 4

This seal pot, in which *S* is from 4 inches to 6 inches less than any seal in the buildings, is placed in the yard, as far from the buildings or holders as possible. Run a pipe the same size, or a little smaller, than the foul main from the foul main at outlet of



WRINKLE NO. 5.

the exhauster to the seal, and another pipe of the same diameter, from the seal about 20 feet into the air. The top of the seal pot should be tight.

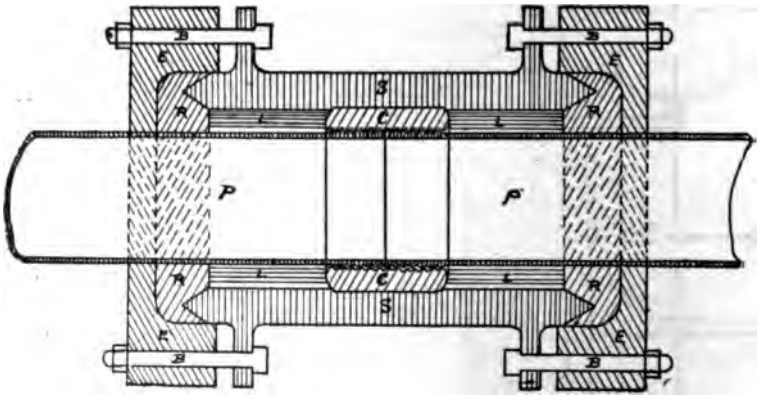
A U-gauge filled with 10 per cent. sulphuric acid, and arranged to ring an alarm when the danger line is reached (See Ohio Association Wrinkles, 1903), should be connected to the foul main, with the alarm bell placed where men are always at work.

No. 4.—*Cold Water for Scrubbing.*—Mr. L. Fitzgerald, of Cleveland, O., sends No. 4, showing a method of obtaining cold water for scrubbers during the summer months, which increases the yield of ammonia. Water is pumped from the bottom of the holder tank by the pump *B*, which discharges into the spray of the final scrubber and also into the cooling tank *A*. After leaving the final scrubber the weak liquor is pumped by pump *E* from tank *D*, through the pipe coils in tank *A*, where it is again cooled, into the first scrubber.

No. 5.—*Drip Separator for High Pressure Line.*—Mr. Geo. F. Goodnow, of Waukegan, Ill., has devised the drip separator shown in Fig. No. 5. This was effectively placed close to the works, and consists of a steel tank with baffle plates inside and a manhole on top. The gas enters by a nozzle at one end and passes out the other end to the street mains. The blow-off is

taken from the bottom of the tank, having a valve in the line, and passes up to above the surface of the ground. To pump the drip, the valve, which has an extension stem, is opened, and the water is blown out by the pressure of the gas.

No. 6.—*Joints for River Crossing.*—A river sleeve is made which is practically a cast iron screw coupling with rubber gaskets at each end, as shown in Fig. No. 6.



WRINKLE NO. 6.

In laying a 12-inch main across rivers with this joint, Mr. J. A. Mayers, of New York City, found that the rubber did not keep the pipe rigid and that the cast iron threads gave way. To overcome these difficulties a wrought iron threaded coupling was cast inside the sleeve, and the space between the sleeve and the pipe was filled with lead and caulked. The result was eminently satisfactory under a 200 pounds pressure.

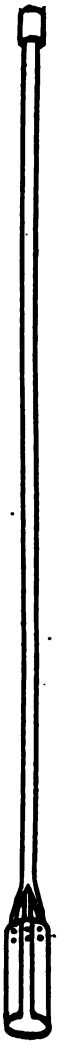
Note the combination of three entirely different joints. The lead serves three purposes: It stops the leaks, keeps the pipe rigid and weights the pipe in the water. Rubber under compression is not readily attacked by gas.

C is a wrought iron threaded coupling cast in the sleeve; *S* is the cast iron sleeve; *P*, the wrought iron pipe; *L*, the lead poured between *S* and *P* and caulked; *R*, rubber ring; *E*, end ring compressing *R* against *P*, *L* and *S*; *B*, bolts.

No. 7.—*Improved Tunneller.*—Fig. No. 7 is a rough sketch of a "tunneller," which Mr. Paul Challis, of Battle Creek, Mich., uses in service construction, and also in laying small mains, for

the purpose of tunnelling under sidewalks, roadways, trees, porches, flower beds or anything where a pipe is to be laid and it is not desirable to excavate. Each service gang is supplied with one, and the mains' gang with two, one extra being kept to change with others needing repairs. The tunneller is patterned somewhat after the Champion post hole digger, but is smaller in diameter and lighter, and is used horizontally instead of vertically. The shell or cutter is made of No. 12 or No. 14 tool steel, of which a piece about 8 inches square is rolled in the form of a cylinder, 3½ inches in diameter, leaving an opening on one side of 1½ inches for the ready removal of dirt. The cutting edge of cylinder is slightly "belled" out so as to cut a hole which will clear, and is sharpened. Three fingers are riveted on the inside of the opposite end, and then welded in the end of a piece of 1-inch pipe about 6 feet long. The cylinder has a slight angle with the handle, to prevent running down in sand. In operating it is used with the slotted side up, grasped near the head end, the handle being allowed to drag on the bottom of trench. An intelligent person with a little practice can direct one of these tunnellers with great accuracy and greater speed than the best shoveller can exert in opening a trench of ordinary depth.

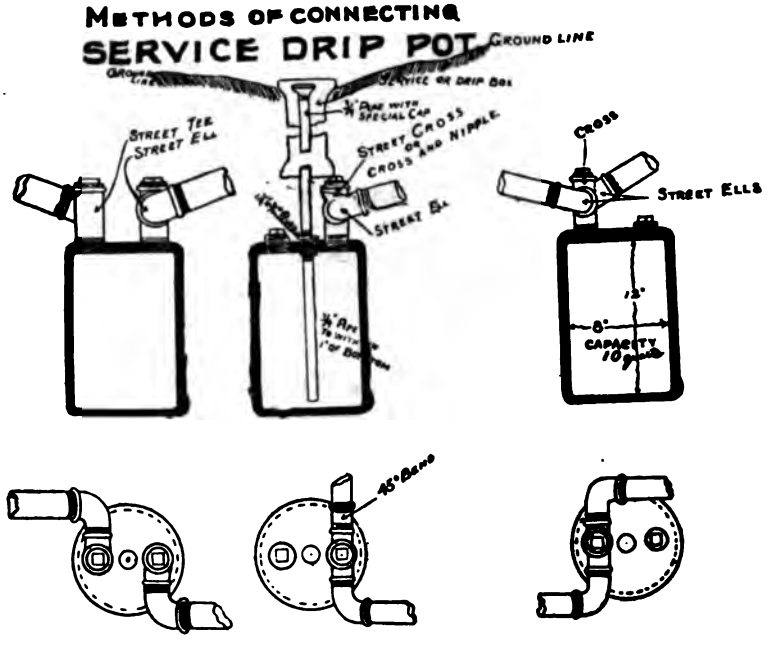
No. 8.—*Service Drip.*—Mr. R. M. Searle, of Mt. Vernon, N. Y., sends illustration No. 8, picturing a service drip pot, the object of which is to have sufficient capacity to permit the storage of at least one year's accumulation of drip water and to prevent trouble and annoyance to the consumer, caused by frequent trips to let drippage out of the end of the service from a drip of small capacity, as is usually the case. This drip pot with a pump pipe also prevents the spilling of drip water in the cellar and repeated complaints on the part of the consumer of a leak that does not exist, but that is due to carelessness of the fitters spilling drip water in the cellars.



WRINKLE No. 7.

No. 9.—*Adjustable Pipe Tapping Crow.*—Mr. A. F. Kersting, of Danville, Ky., sends Wrinkle No. 9, which is intended to represent an adjustable pipe tapping crow, adaptable for use in tapping the smaller size mains (3 to 8-inch) with the ordinary sleeve ratchet, where an improved tapping machine is not at hand. It will be seen that the head of the crow is separate from the stem. A collar of sheet metal is riveted the entire length of the head, which fits snugly around the stem, and an extra collar

or small band is fitted around the first one, at the base of the head, to add strength to that point where the strain is greatest. A heavy set screw passes through the double section of the collar,



NOTE—No bushings to be used. Use long nipples and reducing couplings. Suction pipe in all cases to be outside of buildings.

WRINKLE NO. 8.

by means of which the head is fastened at any desired point on the stem.

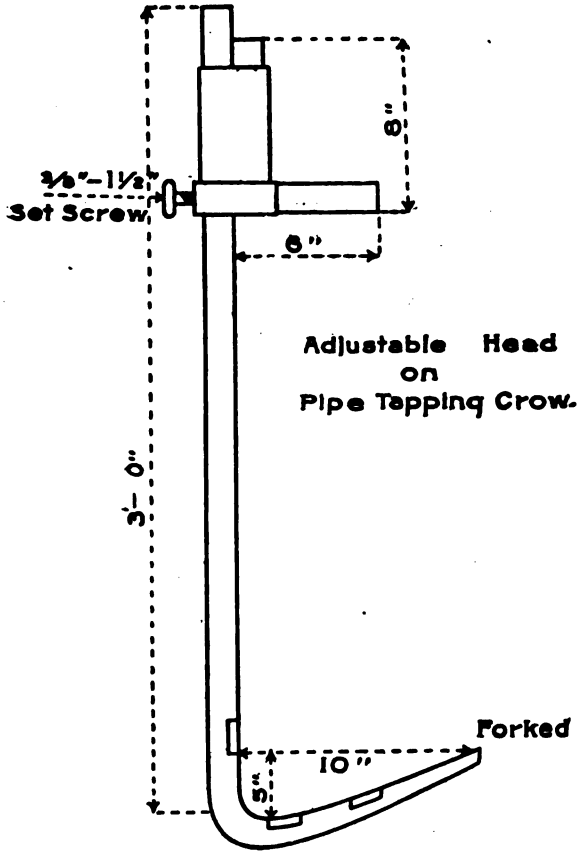
In this manner the same crow can be used on the several sized mains, allowing the head to be placed so that the ratchet and drill fit in comfortably, thus preventing the tendency of the drill to wiggle. Strips welded in the bottom and sides of the heel of the crow also tend to steady the crow on the pipe while tapping.

No. 10.—*Testing New Gas Mains with Air Pressure.*—Mr. J. M. Robb, of Peoria, Ill., states that the Peoria Gas and Electric Company tests every main extension with air pressure at 10 pounds per square inch. The testing outfit consists of:

1 railway gate pump; 2 plumbers' soil pipe rubber testing plugs to fit the size pipe laid; 1 piece of 1-inch hose, 15 or 20 feet

long; 1 pressure gauge; 2 or 3 soap cups, brushes and soap suds.

In making a gas main extension the first two lengths of pipe are left out until the extension is completed, and the end of the pipe at the starting point is plugged with one of the testing



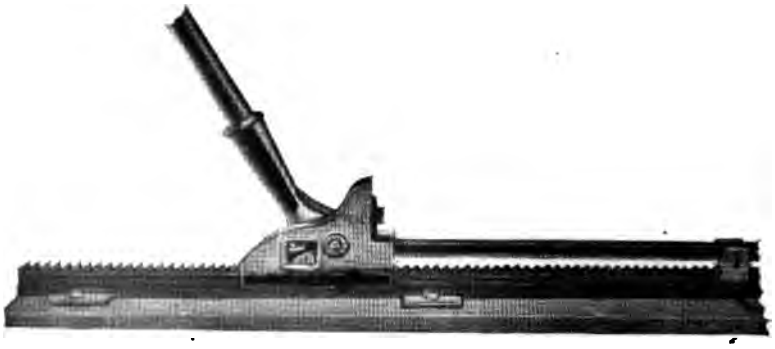
WRINKLE NO. 9.

plugs. When a sufficient amount of pipe is laid, the other plug, with the hose from the pump attached, is inserted in the end of the completed line and the air pressure pumped up to 10 pounds. The joints are then soaped and any leaks found are made good and the pressure is again applied. The tests are continued until the extension is completed.

If the extension is a very long one another break is made in it to avoid the labor of pumping up the pressure on the entire line for each test. When the extension is completed any breaks where the pipe has been left out to facilitate testing are folded in. Then a connection is made between the main with gas in it and the extension with ¾-inch pipe, with a test meter in the connection as a check upon the foreman in charge of the work. Afterwards the first two lengths are folded in and the extension is complete.

In starting with a gang of caulkers who have not been accustomed to the air test a surprising number of tiny leaks, which could not be found by testing with gas at the low pressure under which it is distributed, are shown up; but after a few days' work with the test, the caulkers learn how to drive up the lead so that it is a very unusual thing to find any leaks in the joints.

No. 11.—*Pipe Forcing Jack.*—Fig. 11 shows a jack that forces pipe under ground and dispenses with the tearing up of



WRINKLE NO. 11.

street crossings, lawns, sidewalks or railroad tracks. It is a device that means a great deal of saving and that dispenses with a great deal of inconvenience and destruction in the tearing up of such places. It is submitted by Mr. T. A. McGinley, of Allegheny City, Pa.

These jacks are made to force pipe in various sizes up to and including 4 inches in diameter, and the results that can be obtained with such a device as this can be easily realized. To operate the jack it is simply necessary to provide a ditch about

8½ feet long in which the jack and rack are placed. A piece of pipe is started in the right direction and forced through the ground 7½ feet, which is the total travel of the jack. The jack is then drawn back quickly to its starting point and a new section of pipe placed in position. The operation is thus continued until the pipe is forced the proper distance. This means that the pipe is cut in lengths of about 7½ feet, which is considerably cheaper than digging a continuous ditch and tearing up ground. A ditch at the other end is necessary, if the operator desires to make a connection, but the ditch need only be big enough to meet the requirements whatever they may be. Pipe has been forced with this through workable earth a distance of 150 feet.

No. 12.—*Long Distance Pressure Gauge.*—A new and somewhat novel electrical device for indicating at the gas works the exact gas pressure in the street mains at the office building over 2 miles away, has been in successful service for the past 4 years at the office of the Detroit City Gas Company, writes Mr. Paul Doty, of Detroit, Mich. It was invented and designed for this special service, and a patent has been applied for by the inventor —Mr. H. G. Field—to cover its application to indicating or recording at a distance any pressures, positions, volumes or changes of pressure or position. The application may be made equally well to steam, or any vapor, gas or solid. Fig. No. 12 illustrates the connections and circuits as applied to both an indicating and a recording voltmeter.

The indicating instrument consists of a voltmeter to measure the drop of potential over a circuit of practically fixed resistance, over which a current of constant value is passing. The current is provided by a storage battery and is maintained constant by being continuously charged by current from a dynamo. The current from the dynamo is regulated by lamp or other resistance, so that the charging current is just enough in excess of the battery current to provide for the loss in the battery according to its efficiency. A sliding contact is attached to the bell of a gasometer at the gas office. This sliding contact connects with the various segments of a commutator connected at frequent points on the resistance coil. These points are spaced uniformly with respect to the drop in potential. As the contact point moves up and down, due to increase or decrease of pressure in

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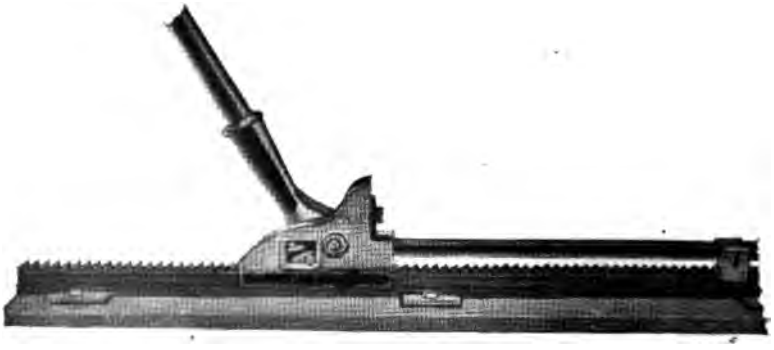

WRINKLE NO. 11.

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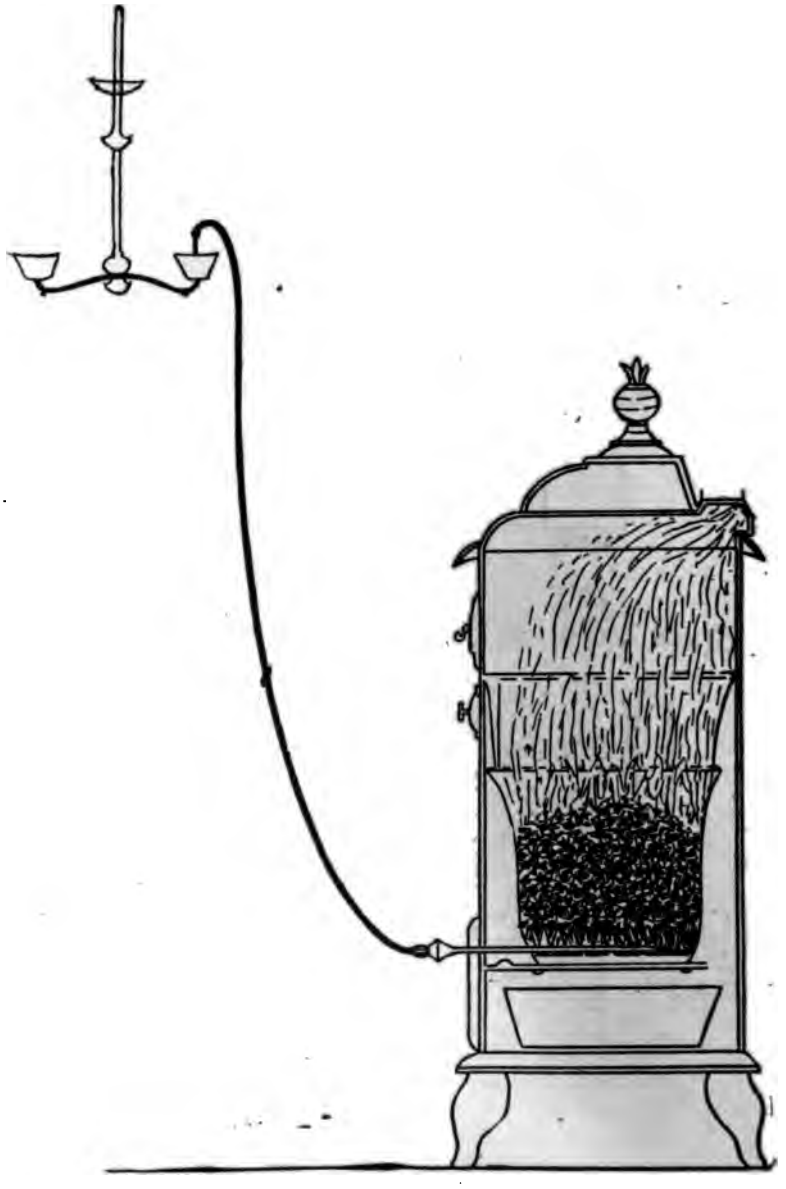
over it. Then a man is supposed to pump up a little pressure and open the ⅜-inch gas cock and at the same time screw up the



WRINKLE NO. 14.

stem of the needle valve which will break or collapse the bottle. This carburets the air with ether and avoids any escape of ether or its odor. It has also the advantage of carburetting all the air that passes through the ether cup so that all the gas piping is filled with odoriferous air.

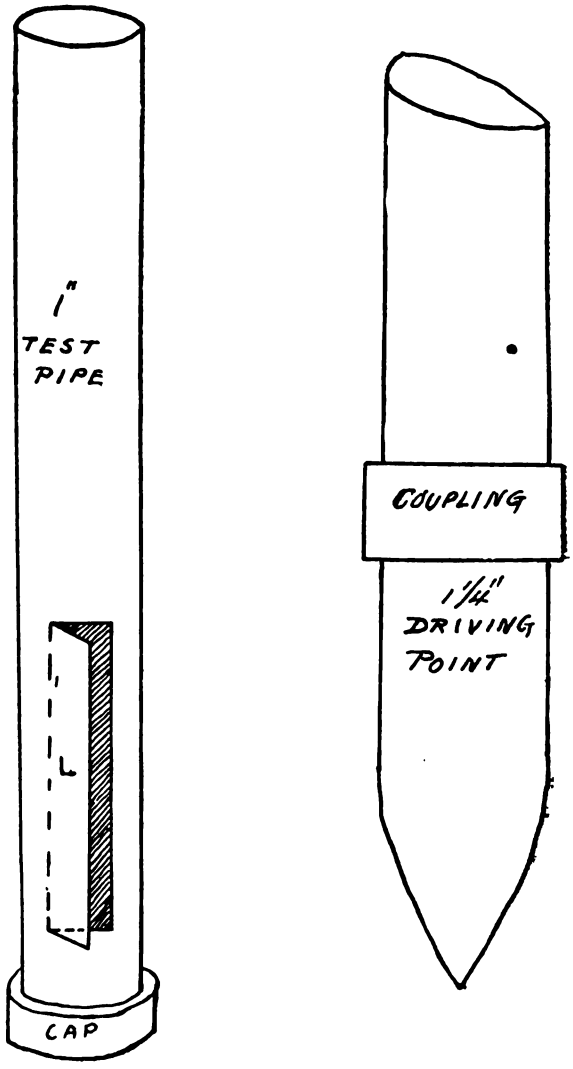
No. 14.—*Bunsen for Lighting Fires.*—Mr. B. F. Perkins, of South Bend, Ind., sends Fig. No. 14, which shows a Bunsen for lighting coal fires, made out of a piece of ⅜-inch pipe, about 12 inches long, flattened at one end slightly and the other end fitted with an air chamber and a jet of suitable size, the outer end of which can be used as a nozzle for inserting into a flexible tube. The other end of the tube is attached to a convenient gas fixture, and the flattened end inserted between the bars of the firepot. To use it, fill the stove up with anthracite coal without the addition of any kindling or charcoal. Light the Bunsen and insert it between the bars of the firepot. This makes a very convenient form for kindling coal fires in a stove or grate in the fall, or at any time that they may have gone out. The fire can be lighted without smutting up the mica and without the annoyance of having to provide kindling, etc.

No. 15.—*Testing for Foundations.*—A simple and inexpensive way of ascertaining the material and depth of each stratum from the surface of the ground, to a depth of about 25 feet or lower, when it is of a soft nature, is shown in Fig. No. 15, and is the contribution of Mr. J. A. Mayers, of New York City.

Attach a driving point to a 1¼-inch pipe and drive this pipe vertically into the ground, coupling on sections of 8 or 10 feet at a time. Then withdraw the pipe by the aid of a wooden horse, as a fulcrum, and chain attached to the lever and pipe. Then take out samples of the stratum every foot down, beginning a few feet below the surface, by lowering a pipe a size smaller—in this case a 1-inch pipe, with a rectangular opening cut near the bottom of the pipe on three sides only. The piece still attached to the pipe is made to project to form a lip (L). When the pipe is turned around the lip scrapes from the point at which it is turned a sample of the material at that point. The testing point (1-inch) should be lowered or raised without rotation.

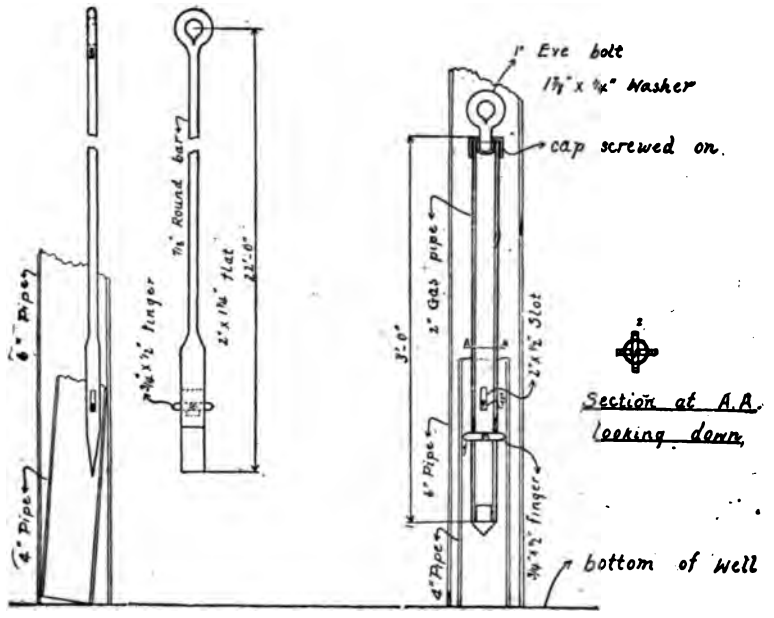
No 16.—*Hoisting Pipe from Wells.*—"This device may be useful to works having water supplied by a deep well of their own," writes Mr. David Buck, of Phoenixville, Pa.

Fig. No. 16 shows a device which was used to lift two sections of 4-inch gas pipe, three lengths of pipe to each section, which, through the breaking of a chain, had fallen to the bottom of a 6-inch bored well, 190 feet deep. A piece of 2-inch gas pipe was taken and two slots 2 by ½-inch cut straight through, one above



WRINKLE NO. 15.

the other and at right angles, and steel fingers Nos. 1 and 2 inserted, which work on a pin or shaft. In lowering this, the sharp point will lead into the pipe, and the fingers, working loosely on the joint, will slide along the side or wall of the pipe;



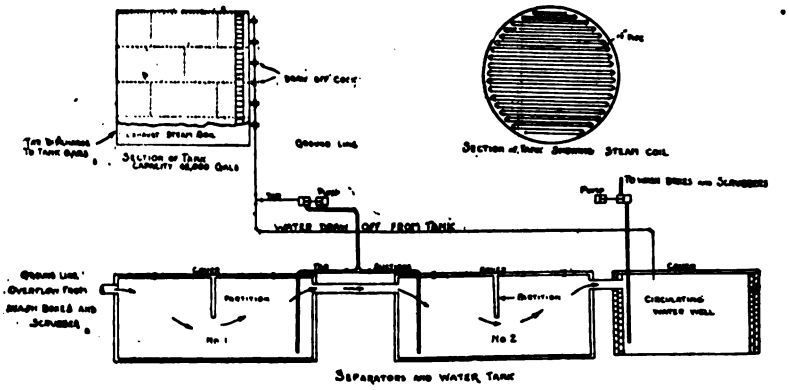
Instruments for Hoisting Sections of Pipe from Bottom of Bored Wells.

WRINKLE NO. 16.

but when pulling back the fingers straighten out and pierce the sides of the pipe, which can thus be drawn to the surface. The cut to the left shows a similar device taking hold of pipe which was crushed in the earth at the side of the well through the force of the second section falling on it and partly closing the end, but by using flat and drawing same to sharp point the work was accomplished.

No. 17.—*Method of Separating Water from Water Gas Tar.*—This valuable wrinkle, shown in illustration No. 17, is furnished by Mr. Howard E. Mann, of Cleveland, O. The emulsion of tar and water from wash-boxes and scrubbers enter separator No. 1

at the top, passes down and under the partition, and into separator No. 2. The tar settles at the bottom of the separators, and the water passing on into the brick tank is pumped again into the scrubbers and wash-boxes. The tar is pumped from separators to the settling tank where it is heated by a steam coil in the bottom of the tank. The exhausts from pumps furnish steam



WRINKLE No. 17.

for coil. As the water separates from the tar it is drawn off into circulating tanks by the system of cocks and piping shown on side of tank. The temperature of the emulsion of tar and water in the separators is about 160° F. This causes the tar to settle rapidly, and the water in circulating wells, 150° F., is entirely free from the tar or oil. After heating the tar in settling tank the final separation takes place, and tar containing less than 1 per cent. of water is drawn from the bottom of the tank. Another advantage gained is the continued use of the separated water, no fresh water being used.

No. 18.—*Office Complaint Slip.*—Mr. B. F. Perkins, of South Bend, Ind., uses the slip shown in the table. When a complaint or order is received at the office a pencil line is drawn through the proper items. A carbon copy is made at the same time, for reference, and a list of the work done by the fitter is made on the back of the ticket, which is signed by the customer.

Name .....
Street .....
Repair stove.....
Leak .....
Poor light.....
Take statement.....Test meter.....
Set stove.....
Set meter .....
Remove stove.....
Remove meter.....
Water in service.....Frost.....Naphthalene.....
Hang fixtures.....Estimate No.....
Service .....
Inspection .....
Mantle.....Chimney.....
Transfer meter to .....
Fitting.....Estimate No.....
Welsbach put up.....
Collect deposit.....Charge.....C. O. D.
Do work .....
.....
Approved for credit { .....
{ .....
.....
.....
Fitters sign here.....

(Front)

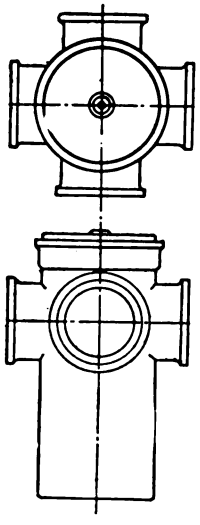
SOUTH BEND, IND., ...1902.

.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
Customer sign here.....

(Back)

No. 19.—*Combination Cross and Drip-Pot.*—Mr. John H. Fitzgerald, of Houston, Tex., would like to know why it is not feasible to make a drip-pot with four bells instead of two, as

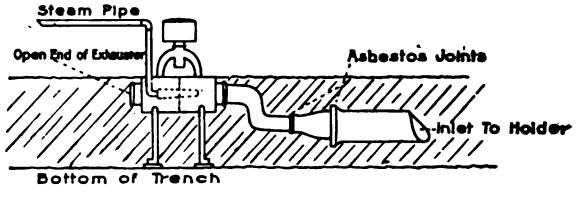
shown in Fig. 19. This would prove a saving in both labor and material when a drip is located at the intersection of two pipe lines.



WRINKLE NO. 19.

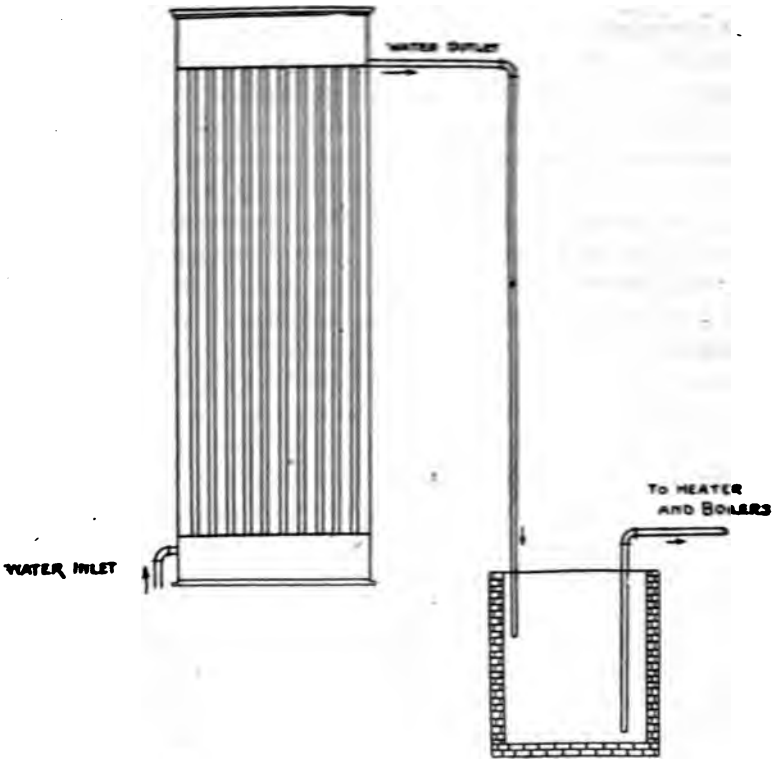
No. 20.—*Testing a New Holder.*—Mr. Jas. T. Pullen, of Alton, Ill., sends in sketch No. 20 an illustration of a simple and cheap means of filling a new holder for testing when first erected. He says: "When our new holder was completed it occurred to us to try filling it with air with an old steam jet exhauster, placed in the trench and connected up to the inlet of holder, as shown. In this way we were enabled to raise the lifts in a few hours, thus giving the erectors a chance to paint the sheets from the runway as the holder went up, as well as test for leaks in the crown."

No. 21.—*Method of Utilizing Condenser Water in Boilers.*—The water enters condenser at bottom, as shown in Fig. 21, passes up through condenser tubes and overflows at top into brick well. The gas is cooled to between 90° and 95° F. at condenser outlet, and the heat absorbed by the water raises temperature of water at overflow to 150° F. The water collected in well is pumped through an exhaust steam



WRINKLE NO. 20.

heater into the boilers, at a temperature of about 200° F. This system, combined with the recovery of water from the water gas tar, reduces the total water used in boilers, condenser, scrubbers, and wash-boxes, to the metered water used in condenser.



WRINKLE NO. 21.

DISCUSSION.

THE PRESIDENT—Gentlemen, you have heard the reading of a very valuable and unique collection of wrinkles which are now before you for discussion, either serially or collectively.

MR. SOMERVILLE—Mr. President, a word about this gas safety seal. We had better not depend upon any seal, but look carefully at the gauges as usual. The next one, about cold water for scrubbing. A word of caution here. There must be a difference of 25° between the water and air; say the water is at 35° or 40° it then meets a stream of gas at 70°. No doubt the cold water will take more ammonia, some 700 volumes I think at such a temperature, but I contend such a fall of temperature will also take from the gas valuable hydrocarbons, and will produce

naphthalene in the inlet or outlet of the holder; such at least has been my experience.

MR. T. D. MILLER—In an experience I had with stopped standpipes, in desperation one of the negroes got on top and poured about a half a pint of dead oil in the pipe that absolutely nothing could be gotten through. Before he could get down the tar, oil and stuff had gone through, leaving a free passage for a fire to be built in the pipe. After that if we had dead oil around the works we used it. In the drip tank shown by Mr. Goodnow I see that he uses baffle plates. I do not see the occasion for such use. In fact, I think they are very undesirable. The resistance of the tank will be increased. The area of the tank being so much greater than the pipe the velocity is reduced and there will be ample time for the condensation to drop before it gets through. You want just as little friction in your mains as possible. I should leave out the baffle plates entirely. The wrinkle relating to complaint slips, where a variety of complaints such as are coming into the office are printed on the slip, resembles slips similar to those in use in New Orleans, and I found having a printed item on it for the character of the complaint to be checked off and handed out to the fitter was very undesirable, because the complaint clerk gets into the habit of doing his work in a most perfunctory way, and the fitter starts out without knowing the slightest thing about what he is going to have to do. The clerk checks off "poor pressure" or "burner," something of the kind, and the fitter doesn't know what he is out for at all. We have changed all of that. Our complaint slips are absolutely blank, and the complaint clerk is required to write out as fully as possible the information he can get from the consumer who comes in to make the complaint, so when the complaint man starts out he has all the information that it is possible to have up to that time in regard to that complaint. We use one of these recording, copying, duplicating machines, made by a concern in Niagara Falls; a blank sheet and a printed sheet, with a carbon sheet between which makes a duplicate at one writing. They are not thrown around on the desk, nor is there any chance to lose the consecutive numbers. When the complaint slip is torn off, the duplicate is torn off with it and filed, so as to keep the complaint men checked up and know that they are promptly returning their work. Then

these slips after they come back are indexed by their numbers. We use two indexes. One is an index for the consumer, the other for the locality. The number on the slip is all that shows on the index. The locality index will show if we get a series of complaints from certain localities, or the other will show if we get a series of complaints from the same consumer. In that way I expect to get a great deal of benefit from the information that will be filed. This wrinkle relating to raising a holder with air pressure states that one of the objects therefore is to give the holder builder a chance to paint the holder. I don't think it is a very good practice to attempt to paint a holder immediately after it has come out of the water, unless it was rising very, very slowly.

MR. J. H. FITZGERALD—In regard to drip described in Wrinkle No. 8, I will say that I have used a similar drip for the past 5 or 6 years. The connections are not exactly the same, as we make them in the way most convenient for the location; but the drip is satisfactory and I consider it a good thing and deserving of consideration.

MR. R. M. SEARLE—In regard to the service drip pot I would say that the reason that it is always placed outside of the cellar is that we thought if we put it in the cellar there was a chance of its freezing and bursting with disastrous results. During the winter we took six of these and filled them with water to make the test for bursting, and also filled six No. 11 Eclipse Gas Stove Company's furnace water heaters. All the drip pots as shown in the wrinkle burst, while none of the furnace water heaters burst. This shows that these water heaters make good service drip pots and could be used safely in a cellar. We will use these furnace water heaters as a drip pot in the future; however, the pump pipe should be brought out of doors. A large number of complaints of leaks we received during the winter a year ago, turned out to be drip water spilled from small service drips in the cellar, and many of these "leaks" we were called upon to remedy two or three times, whereas if the pump pipe had been out of doors we would have had no complaint or dissatisfaction on the part of the consumer.

MR. MITCHELL—Referring to No. 14—Bunsen for lighting fires—I would say we have followed that method largely The writer

says fill the stove up with anthracite coal; I say, use coke in stoves.

MR. FITZGERALD—Replying to the point brought out by Mr. Somerville in regard to Wrinkle No. 4, I would like to say that putting water 25° colder than the atmosphere into the final washer does not throw out naphthalene, because we have already passed the gas through a multi-tubular condenser that is cooled to the same temperature as the water in the washer, and all naphthalene that will drop is taken out in the condenser.

MR. W. E. HARTMAN—I wish to indorse the second wrinkle, that of burning out stopped pipes with the aid of a forced draft induced by means of a steam jet in the pipe. We at Norfolk, Va., have also used this method of cleaning stopped pipes, and I can heartily recommend it to anyone having any trouble with standpipe stoppages. Previous to using this method, we reamed each pipe from the bottom every 4 hours and from the top every 24 hours with large reamers. Whenever we could not force the reamer through, we would burn out the pipe with a wood fire in the mouthpiece. This would take about 4 hours, and sometimes as much as 8 hours. Now using this method, we ream each pipe every 4 hours only from the bottom, with a large, short-handled reamer, and once in three weeks on the average we burn out each pipe by this steam-jet method. This takes 20 minutes and cleans the pipe so thoroughly that it runs 3 weeks before requiring cleaning out again. We have felt so gratified over the success of this ready method of taking care of standpipes that we wish to recommend it to others.

MR. STEINWEDELL—I would like to say in reference to the wrinkle for drip separator, by Mr. Goodnow, that the separator has a very large area, and the gas going through at a high pressure, one would find by putting a pressure gauge on the outlet ends of the separator that there was no drop in pressure with baffle-plates any more than without baffle-plates. Certainly it gives the gas a little longer course in going through the separator and it will deposit more water.

MR. GOODNOW—I have been asked for a little more information about condensation products in this drip where we think we catch nearly all the condensation. We found with coal gas, which we have been making exclusively for the last two or three months, that we separated at this drip about a gallon of oily

matter to 12,000 or 15,000 feet of coal gas and about as much more of what is apparently nearly clear water. It may run 1 gallon of water to about 10,000 feet of gas compressed. Three or four of these samples of oil have a gravity of about 31, a little heavier than gas oil. These samples are now in the hands of the chemist of the Milwaukee Gas Light Company for analysis, and we hope to get a little information as to the distilling points and other features of this condensation.

MR. MILLER—I would like to ask what is the size of the pipe you are compressing that gas through?

MR. GOODNOW—Four inches.

MR. MILLER—What is the quantity of gas compressed through it?

MR. GOODNOW—About 10,000 to 15,000 feet per hour.

MR. MILLER—Its velocity in the pipe is not very great, then?

MR. GOODNOW—No; not very great.

On motion, Editor Steinwedell was voted hearty thanks for his trouble and labor in the matter of putting together the budget of wrinkles presented.

Next in order was the paper on

HEAT CONDUCTIVITY OF GAS RETORTS,

by Mr. H. A. Wheeler of St. Louis. Mr. Wheeler not being present the paper was read by the Secretary as follows:

The Problem—The problem is to determine if different makes of gas retorts have different rates of transmitting heat, and if so, to what is this difference due; *i. e.*, whether to the clays employed or to the difference in making up the retorts as far as this could be determined in hand samples.

The Samples—Samples were furnished by four manufacturers, who are respectively designated, *W*, *X*, *Y* and *Z*. The request was made to furnish fragments from retorts that represented (a), the normal burn; (b) an overburn; and (c) an underburn. With one exception there was no appreciable difference in the samples furnished from a normal burn which is intentionally made soft, to enable the retort to withstand the violent changes in temperature it has to endure in charging.

The samples furnished were trimmed down to 6½ by 8½ inches, except *W*, of which only one sample was furnished, and

it was 4 inches by 8 inches. This under size was very unfortunate, as it prevented direct comparisons being made with the other samples, though its value could be approximated by correction.

Sample *W* is convex, and, therefore, from the sides or top of the retort. The body is white, rather tender, porous, and soft burned. It contains considerable "grog," perhaps 30 per cent. or so, which is coarse, and consists of mostly pre-burned clay with some coarse quartz sand. The inside is glazed with a transparent film of glass (to reduce gas leakage).

Sample *X* comprised four specimens that were all well burned, strong, brown color, and contained perhaps, 25 per cent. or so "grog." The grog consisted of pre-burned clay, and was rather fine, except in No. 1, in which it was very coarse.

Samples Nos. 1, 2 and 3 were flat or from the bottom of the retort, while No. 4 was convex, or from the sides or top.

Samples *Y* consisted of three specimens that were all flat or from the bottom, and were very similar in texture. The body was white, very tender, porous, and soft burned. The precentage of grog was very heavy, perhaps 50 per cent. or so; rather coarse, and mainly consisted of pre-burned clay, with some coarse quartz sand. The inside was smeared with a brown slip (to reduce gas leakage).

Samples *Z* consisted of three specimens, two being flat and one convex. They were similar in texture, having a slightly brownish color, rather porous, rather strong, and fairly well burned.

The samples not only differed in thickness, but were found to vary $\frac{3}{10}$-inch to $\frac{10}{100}$-inch in thickness, as determined by calipers, in different portions of the same specimen, and the thickness subsequently given was the average at the place tested. As gas retorts are poor conductors of heat, the thickness is a very important factor, as increase in thickness produces an increase in the resistance to heat transmission. While this is a theoretical premise, the diagram illustrates that it is well borne out in actual results.

The samples that were *convex* give somewhat better results than *flat* samples of the same material. This is due to a slight concentration of the heat produced by the convexity, and a similar benefit would be obtained in actual practice. There were sufficient flat specimens, however, to obtain satisfactory

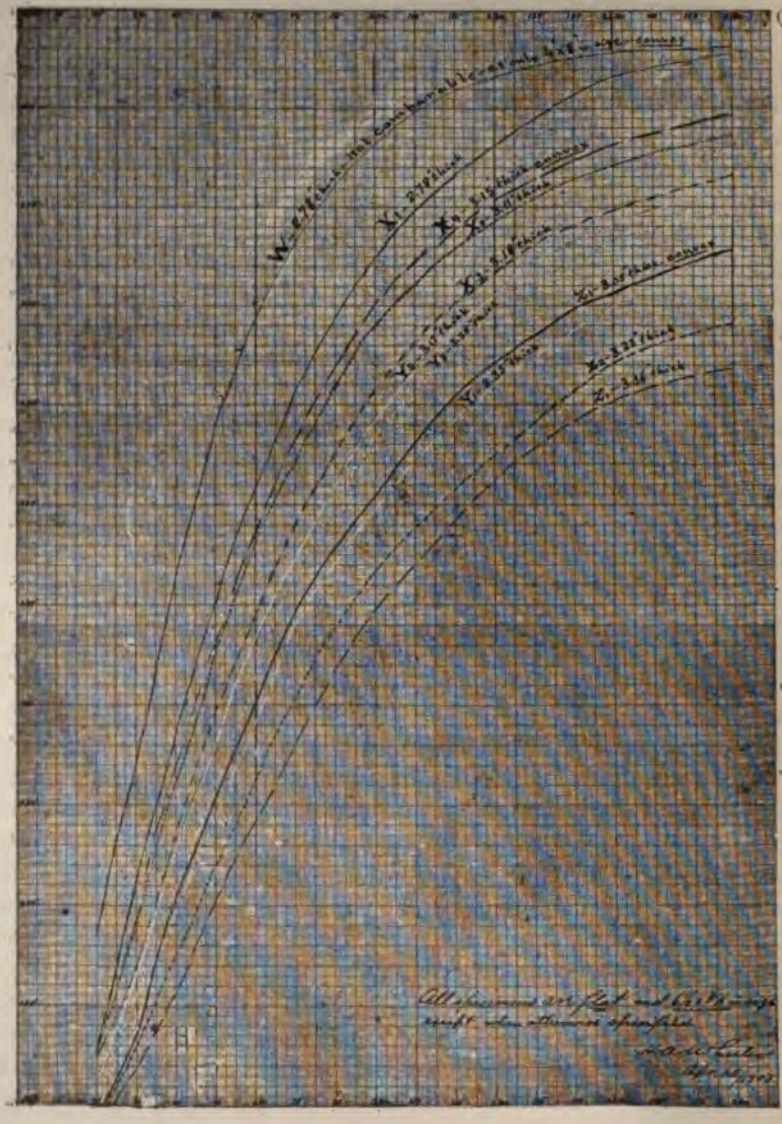
comparisons of the different samples, without having to consider this slight benefit due to convex shape.

Method of Testing—After considerable experimenting to determine a method that would correspond as nearly as possible to the working conditions, and which could be so controlled as to give uniform conditions, the following method was employed:

A small, rectangular brick furnace was built that was 7¼ inches high, 8½ inches deep, and 6 inches wide, in the clear. The side walls were 4 inches thick, and ¼-inch thick asbestos boarding was used for the front and back walls. The specimen was set across the top of this furnace, leaving a 1-inch by 6-inch slot on each side for the escape of the gases. The under side of the specimen was heated to a bright red heat by a special Bunsen gas burner placed in the furnace, and the temperature of the top or opposite side was taken every 10 minutes with a high grade thermometer (Green), the bulb of which was covered with steel filings to insure a good contact. The entire top of the specimen, including the thermometer, was covered with 8 thicknesses of heavy asbestos cloth, which aggregated 1½ inch in thickness, to prevent radiation. A double shield of white asbestos board, set on the stem of the burner, to reflect the heat back onto the specimen, and the furnace was kept continuously hot. With these conditions duplicates checked satisfactorily.

The temperature was read every 10 minutes from the time the specimen was set on top of the furnace until it had nearly attained its maximum temperature. Starting with a temperature of 74° to 82° F., it was found that the increase in heat shown by the thermometer, or the rate of transmission through the specimen, with the underside at a bright red heat (or about 1,400° F.), was *very slow* for the first 10 minutes, in fact, *no increase* with the *Z* series; was less slow for the next 10 to 15 minutes; and after 20 to 25 minutes, the increase in heat or the *rate of transmission*, was *very uniform and regular* in every case for about an hour thereafter. This rate of increase practically follows a straight line, or a tangent to the hyperbola in the diagrams shown on the accompanying chart. This chart gives the entire information as to the time heated and temperatures obtained, in which the ordinates or *vertical* ranges are the *temperatures*, and the abscissa or horizontal ranges are the *times*. From thence the *rate* of transmission was less rapid as the top

became hotter, until in three hours' time the top has become nearly as hot as it could be made by this outfit, and the curve became nearly flat. The curve became quite flat or horizontal, after the other tangent of the hyperbola had been reached, when



the heat was continued for about an hour longer or about four hours in all; but this is not shown in the chart, as the *differential rate* of *transmission* of the heat was already clearly shown in the first two hours. For as the specimens all start at nearly the same temperature, it required about 1½ hours heating to develop and bring out the respective heat conductivity rates of each specimen, which is the information sought, and which the curves of each specimen down in the chart clearly show.

Discussion of the Results.—A study of the curves of each specimen shown on the chart shows a marked difference in the heat conductivity rates of each group or make of samples, as well as between different specimens from the same manufacturer. (Each group or make is shown by a different color.)

The sample *W*, of which only one specimen was furnished, must be eliminated in the comparisons with the others, as it was about 50 per cent. narrower or smaller than the others, and hence would *heat up very much quicker* for the same amount of heat.

By experimenting on a similar narrow specimen of one of the other samples, it was found to increase its heat conductivity rate in about the same ratio as its volume was diminished. By correcting from this basis, and again correcting for its convexity and thickness, it seems probable that *W* sample would be equivalent, if flat and of the same thickness, as specimen *Y* 3, and this *W* sample need not be further discussed.

Before considering the individual rate of heat conductivity of each clay, there are other physical factors entering into the problem that should be considered, as these will affect the different specimens from the same clay or factory. These physical factors are: *Thickness*, *specific gravity*, *porosity*, *grog* and *shape*, and their value in the specimens tested is shown in the following table:

Table of Physical Factors.

Specimen.	Thickness. Inch	Specific Gravity.	Absorption in 24 Hrs. Per Cent.	Hardness.	Grog.	Shape
1–X	2.78	2.43	8.3	6	Low	Flat
2–X	3.11	2.42	8.5	5	"	"
3–X	3.19	2.41	8.0	5	"	"
4–X	3.15	2.37	7.3	5	"	Convex
....	....	....	....	....	....	....

Specimen.	Thickness. Inch.	Specific Gravity.	Absorption in 24 Hrs. Per Cent.	Hardness.	Grog.	Shape.
1–Y	3.35	2.27	13.7	3	Very large	Flat
2–Y	3.17	2.30	13.6	3	"	"
3–Y	3.25	2.30	13.6	3	"	"
....	....	....	....	....	....	....
1–Z	3.36	2.41	10.6	4½	Very large	Flat
2–Z	3.23	2.36	11.2	4	"	"
3–Z	3.04	2.35	10.7	3½	"	Convex
....	....	....	....	....	....	....
W	2.78	2.26	11.9	4	Large	Convex

Thickness.—The factor of thickness is very important, as is well shown in Nos. 1, 2 and 3 of the *X* series, in which the other physical factors are so nearly alike as to make these an excellent comparison of its value. For the same reason, Nos. 1, 2 and 3 of the *Y* series clearly show its bearing and value. The results of all tests made show that the heat conductivity rate varies inversely as the thickness, or the *thinner* the *retort* the *more rapidly it works off its charge.* Of course, there is a limit in practically applying this, as the breakage will become too great if made too thin, and it will require intelligently directed experience to determine how thin a retort can be made to withstand ordinary usage in order to increase its efficiency. A decrease of 10 to 15 per cent. in thickness, at least in such strong clays as *X* and possibly *Z*, could probably be safely made, and thus improve their gas making value 10 to 15 per cent.

Specific Gravity.—As a broad rule in physics, an increase in specific gravity increases the thermal rate of conductivity. A study of the data, in which there is only a moderate variation in the specific gravity, does not show any marked bearing, and as this factor also reappears in the individuality of the clay itself, it will not be further discussed.

Porosity.—Another general rule in physics is that increase in porosity decreases the thermal gradient. The measure of this porosity is best obtained by the increase in weight resulting from soaking in water. After testing the absorption by soaking in water from 1 hour to 5 days, it was found that if the dried sample was soaked 24 hours it gave satisfactory results as regard its porosity. As the porosity decreases the harder retorts are burned (and would be entirely eliminated if vitrified like glass), and as the

hardness increases the harder a clay is burned, the hardness (as measured by Moh's scale of hardness, in which soft clay is 1 and the diamond is 10), was also determined to estimate the burning, and, consequently, to a considerable extent, the porosity.

While a study of the data shows that the *X* series, which have decidedly the least porosity as measured by the low absorption and high hardness, are decidedly more efficient; still this factor as a whole shows only a small influence, and the data at hand is too meager to estimate its value. Like the specific gravity, this factor will more strongly show in the clay itself and its treatment, so it will not be further discussed.

Influence of Grog.—The grog or non-shrinking material that is used in the body to reduce shrinkage and prevent cracking in drying and burning, and to also enable the retort to withstand the violent changes in temperature in charging, was found to vary greatly in kind and amount in the samples submitted. While the data indicates that an increase in grog decreases the heat conductivity, this is a matter that cannot be discussed from lack of information the manufacturers decline to furnish. It is best considered in the individuality of the retort, as each maker has his own ideas as to the quantity of grog required to produce the best retort.

Shape.—A convex shape increases the thermal gradient, as shown by the tests and as indicated by theory; but as enough flat or similar types were sent to make satisfactory comparisons, this will not be further considered, as the bottoms are always made flat and the sides and tops convex.

Heat Conductivity of Different Retorts.—After allowing for the influence of the previous factors as far as possible, the data shows that each of the three different makes of retorts, under the same conditions, have a relative efficiency of about as follows: 100: 110 to 120: 130 to 150, or the *X* to *Y* to *Z*. These values are approximate, as the material was insufficient to arrive at more exact results. But it is also quite likely that different retorts, as made on different days in the same factory from presumably the same material, will show quite as much variation in their efficiency, owing to the conditions under which they are made.

Resume.—The three samples submitted show that there is a variation of 10 to 50 per cent. in the efficiency of heat conductivity rate of these three different makes when of the same

thickness; that thickness is a very important factor, and the efficiency of all retorts as heat conductors will be proportionately increased as the retorts are made thinner. How far this reducing the thickness to improve the efficiency can be safely carried will have to be determined by intelligent experience.

DISCUSSION.

THE PRESIDENT—Gentlemen, I regret very much that Mr. Wheeler is not here to answer any questions that might be asked him. However, this topic has interested me for several years, because I have observed very great differences in retorts, not only as to makes but as to different retorts, from the same maker, and I induced Mr. Wheeler to take it up thinking that the retort makers would join me in giving him any assistance necessary in the way of furnishing samples of different degrees of burning and what not. After a good deal of effort, I was only able to obtain three samples, which accounts for the sparseness of Mr. Wheeler's experience and his comments on this very interesting topic at this time, when we are all looking out for economy. If we could get a retort with an increased conductivity of 50 per cent. over that which we ordinarily get, I think the carbonizing effects would be materially reduced. I think it is time that gas engineers would make specifications like they would for other things, and would only accept what they want, not remaining satisfied with anything that the retort makers seemed willing to send to them. The only specification that I am aware of now that you prepare is providing for a retort that wont break when it falls off a railroad train. That seems to be the principal thing. I would like to have the paper discussed in a general way.

MR. THWING—The writer spoke about the porosity of retorts affecting their thermal efficiency and conductivity. It is undoubtedly true that any porous material is a non-conductor of heat or cold, but Mr. Bredel in a remark he made to me developed a point (which he seemed to be unwilling to make at the present time) that in practice retorts in a short time become saturated with carbon. We all know retorts become much denser after being in use for a short time, and that the heats on the retorts become better, so that probably a series of experiments like these

would not be of as great value as a series of experiments upon portions of retorts which had been in use for a certain length of time. It is necessary to have retorts porous, as I understand. I have been brought up to understand that a considerable amount of burned material has to be used in them in order to make them refractory. I am of the opinion that the writer has made the amount of grog (as he calls it) or burned material too low, although I don't know the proportions of the manufacturer. I think that probably 50 per cent. of the retorts in our gas works consist of burned material, and my experience has also been that the more burned material that is included in retorts the better the retorts are. It is more refractory to heat and less liable to crack. So it seems to me we cannot avoid this porosity in the new retorts, but that it is overcome later on by the accumulation of carbon from the gas that is made in the retorts while they are being used in the benches. This paper is very interesting and valuable, and I am of the opinion the experiments should be carried further. The conclusion that the author reaches that there is a difference of 50 per cent. between the conductivity of different retorts (I believe he says different retorts of the same maker) is very surprising indeed to me. I do not understand, simply for the reason in the nature of the work that a retort has to do its conductivity is added to, that it removes any necessity for improving the initial conductivity. If you could improve the initial conductivity of this retort 50 per cent., then add your graphite or carbon as an additional conductor, you would have still a 50 per cent. better retort. I cannot see the power of the argument.

The next number was the paper on

MUNICIPAL OWNERSHIP OF PUBLIC UTILITIES,

by Mr. A. E. Boardman, of Brevard, N. C. Mr. Boardman being absent in Europe at the request of the President Mr. T. D. Miller read the paper as follows:

In requesting a paper on municipal ownership of gas works your Executive Committee has assigned a most difficult task. It is almost impossible to write anything new upon a topic which has created such universal interest and controversy as this. Hence a presentation of the arguments pro and con must at

this late date be in the nature of a compilation rather than the introduction of original ideas.

Municipal ownership, not only of gas works but of water and electric works as well, is a subject of pressing importance to all urban communities, and considerations affecting the advantage or disadvantage of such a policy should be thoroughly understood by all. These considerations apply in a general way to any municipally owned and operated public utility, though with varying force. They may therefore be discussed under the general title of municipal ownership of public utilities, rather than of gas works alone.

The tendency in this country is now, and has been increasing for some years, to try municipal ownership of all public utilities as a panacea for the ills and annoyances which the operation of such utilities inflicts upon the communities in which they are located, and the magazines and newspapers teem with articles advocating such a policy. Statements of the advantages to accrue to the public and arguments in favor of adopting it are the stock in trade of politicians seeking office, and public cupidity is stimulated by skillfully prepared statistics proving the vast profits to be derived therefrom.

Discussions on this subject have often reached an acrimonious stage, since the "point of view" in such a controlling factor. As arguments for and against the tariff appeal differently to producers than to consumers of protected articles, so stockholders do not look so favorably upon municipal ownership as those who have no interest but to pay the bills. It is contended that things which our civilization has advanced from mere convenience or luxuries to necessities, and whose distribution or operation demands so large a portion of the public right of way, should be owned by the public so as to be absolutely under its control and management.

In the case of lighting plants it is contended that since the municipality is in its streets and public lighting often the largest customer, and since the comfort and safety of the people are so dependent, in, on the purity and light giving power of the article furnished, the control and regulation of such plants should be absolutely in the hands of the municipality.

Likewise, in the case of water works, since the health of the community is dependent upon the purity of the water furnished,

its comfort and cleanliness so dependent upon the quantity furnished, its safety so dependent upon the pressure at all times available, and its public needs in its street sprinkling, sewer flushing, fire protection, etc., are such large portions of a water works' functions, it is contended that the ownership and management should be in the municipality.

It is contended in the case of street railways that since so much of the streets is permanently occupied and used by them, the comfort and convenience of the public being so dependent upon their management, they also should be owned and operated by the municipality. They say that the municipality has in its police powers and police force greater ability to discover and correct shortcomings and abuses incident to corporate management and corporate greed. They insist that the profits derived from such undertakings, over and above the cost of operating them, should be devoted, first, to defraying the cost of the public service, and then to reducing the price to the consumers, so as to lower the cost of living and increase the number able to avail themselves of these utilities.

It must be admitted that theoretically these arguments are powerful, and to many minds convincing; but in the words of one of our country's greatest statesmen, "It is a condition and not a theory which confronts us."

Primarily, it cannot be too positively demanded by a free people that governmental activity should be restricted to purely governmental functions. To enlarge its sphere of activity is to enlarge the number of voters dependent upon those elected to the higher offices, and so the freedom of the ballot becomes restricted, and the power of parties increases at the expense of patriotism. In a free country capital and labor should have the largest possible scope for profitable employment, and wise competition should be encouraged for the purpose of cheapening the cost of production and perfecting methods and machines. When the government usurps any industrial enterprise, just so much is the field for profitable employment restricted and healthy competition destroyed. The vigorous growth of interested energy gives way to the dry rot of supine officialdom.

As very forcibly said by Mr. John A. Britton, of Oakland, Cal., before the Pacific Coast Gas Association in 1896: "The protection of capital and the protection of labor are duties of

governmental bodies far above and beyond that of any other sphere in which they may work. The destruction of capital means the destruction of labor. The protection of capital means the protection of labor. One is as much dependent upon the other as the life of plants is dependent upon the sunshine." Any candid mind will concede that where the public confers upon a corporation extraordinary privileges, such as permanent rights of way in streets, the right of eminent domain, or franchises in a community, it is entitled to insist upon certain duties being performed, and also to exercise a supervision over the operations of such corporations as is necessary to enforce the performance of such duties. This does not mean the ownership and entire management of such operations. On the contrary, such ownership and management would defeat the very object of a wise, disinterested governmental supervision, as will be hereinafter shown.

A supervision, as above conceded to be reasonable, should be both wise and disinterested to properly fulfill its functions. It should be exercised by persons of discretion and knowledge in the industry under consideration, and not subject to the influence of local feelings, often wrought up by irritating but purely local causes. Hence, the State and not the municipality affected should constitute the supervising board, That such a course is practical and efficient is abundantly and most satisfactorily proven by experience in the State of Massachusetts, whose Board of Gas and Electric Light Commissioners has done such excellent service both to the people and to the lighting industries of that State.

That municipalities have the power to enforce regulations affecting the purity and efficiency of their supplies, and are equipped with the machinery to promptly give information of, and to rectify, abuses is true; but these powers are seldom used to rectify abuses within itself except under pressure of public opinion. Since when have fellow servants in a household acquired the habit of informing upon each other's shortcomings to the common master? In what city, owning its lighting and water plants, is the public kept informed by the police of negligence in the lighting department, or by the firemen of lack of water or pressure in the water works department? Where these utilities are owned and operated by private corporations it is universally the case that the slightest deviation from contract

requirements is not only promptly reported, but also published; so that the authorities may not only act to rectify the trouble but that such action may be sustained by public opinion. The public servants act for the protection of the rights of the public, and so long as they stop short of unjust accusations and persecutions this state of things is right and in the interest of the whole community. As soon as the city acquires the utility plants all this is changed. It becomes the interest of the administration to hush up all complaints; for is not the administration responsible for the acts or negligence of any of its departments, and is not the charge of dereliction of duty in any of them a reflection upon the administration? Hence it is that in municipally owned works it takes a long time to rectify abuses, because it frequently requires a change in the administration before it can be effected. This is very difficult in any case, and is rendered still more difficult the greater number of voters employed in the municipality.

In many places the citizens suffer without complaint or with only murmurs, because they feel the uselessness of complaining, and bear for months with a state of things they would not tolerate a week if the works were owned by private corporations. Take the city of Philadelphia, for instance. For years the citizens suffered from insufficient pressure in mains and poor quality in the gas, together with higher prices than charged in any other large city in the country. They made ineffectual efforts to improve the service, even by changing the administration, and making the gas supply an issue in several municipal campaigns. Finally, in desperation they parted with the control and management of their gas works to a private corporation, with very gratifying results to the community at large and with profit to the corporation. So greatly improved is the service that a proposition to sell the works outright to a company has been seriously considered, and would doubtless carry if left to a vote of the gas-using public.

In the same city the people have suffered during a decade from a turpid and health-menacing water supply which they would not have tolerated if furnished by a private corporation for six months. And now, when forced by public opinion to adopt a system of filtration and purification, the authorities have selected a most expensive method both to construct and to operate, and the cost to the public will be double what it should be.

Observe the great city of New York. The mere matter of waste in its water supply has grown to such proportions that double the necessary amount is being distributed with consequent decrease in pressure and increase in cost. The people are asked to raise one hundred millions of dollars to increase the supply, when if owned and managed by a private corporation the object would be accomplished at an expense of ten millions of dollars by the use of well known methods, and in a manner not to work a hardship upon the people so far as their actual needs are concerned. In fact, a private corporation would not have permitted waste to grow to such proportions, and the pressing problem of the city would have long ago been solved.

The most appealing argument for municipal ownership is that of reducing prices to consumers and in getting the public supply free. This is based upon a fallacy, but the contention is difficult to disprove, because the accounts of municipalities owning public utilities are generally so involved that it would require weeks of expert accounting to properly classify the items of expense chargeable to the utility plants. Interest on the plant investment is one large item which is seldom considered. In this respect, and in this only, is the city at an advantage over a private corporation. It can generally borrow money at a lower rate, but this advantage is offset many times by wastefulness in municipal management. That municipal management is less economical than private management is a fact beyond dispute. That it should not be so may be admitted; that it *is* so *must* be admitted. It will hardly be gainsaid that any public work, even to street cleaning and sewer flushing, can be more thoroughly and economically done under private than under municipal management. Intelligent self-interest will compel the employment of tools and machines of highest efficiency, while only the necessary number of men will be employed and all of them will be required to give full value received for their wages. The city administration is chary about spending the people's money upon improved machinery, but lavish in expending it upon men who vote and can enhance the power and permanence of the said administration. This should not be so; but it is so, and cannot be changed, even by changing the party in power.

Hence it is that, no matter how alluring reports from municipally owned works may appear, the absolute cost to the

community is greater than in a well managed private works. One convincing test may be applied to cities owning their public utility plants: Has such ownership resulted in decreasing the valuation placed upon property for taxation or in the tax rate? If not, either there is no real profit to the community, or there is gross extravagance in other departments.

Frequently the public is deceived by a lowering in the price to the actual consumer while the budget suffers to make up the deficit. In other instances the price to consumers is higher than in cities of similar class which are supplied by private corporations, and considerable profit is carried to other accounts. But since no charge is made on the books for interest on the investment the profit is only apparent. Low prices to consumers is by no means the rule in municipally owned works, and in trying to maintain them the authorities are frequently brought face to face with the alternative of increasing the price of the service or of the tax budget. At the time when the city of New York is considering the advisability of building its own gas plant, the city of Wheeling, W. Va., with the second largest municipal gas works in the country, is seriously considering how to avoid raising the price of gas to consumers; and this in close proximity to the coal fields.

The largest gas works in the world, furnishing gas at lowest prices to both public and private consumers, are owned and operated by private corporations. In England where the most thorough and exhaustive tests of the comparative advantages of the two systems have been made, the conclusion has been reached that municipal ownership is not so advantageous as private ownership under a wise governmental supervision—a supervision which protects the public against inferior service and yet assures to capital a security and remuneration far above anything of the kind in this country. If it were possible to induce our law-makers to desist from senseless and often ruinous attacks upon legitimate investments in public utility plants, and to turn their attention to aiding both the public and investors in obtaining and supplying cheap products, on lines similar to those so efficacious in England, it would prove a blessing to all concerned.

The matter may be summed up by saying that municipal ownership of public utilities is safe and profitable only in that city whose streets are kept perfectly clean and in good condition;

whose public buildings, parks and other city properties are kept in thorough order and repair; whose excise laws and all city ordinances are enforced without fear or favor; whose police and fire departments are conducted in the most efficient and honest manner; whose sanitary department is prompt and fearless; and whose finances are managed as economically and accurately as in its large business houses. Where there is room or need for improvements in any of these matters that city had best refrain from municipal ownership of public utility plants.

DISCUSSION.

THE PRESIDENT—Gentlemen, you have just heard this paper written by Mr. Boardman. It strikes me as one of the cleanest, clearest-cut statements of the municipal ownership question that I have heard. I would like to have it so discussed by the members as its importance demands.

MR. BUTTERWORTH—I do not think municipal ownership of gas works is a very active movement just now in this country. I know of but one instance in this country where a municipality has taken over a gas works in the past 10 or 15 years—that of Holyoke, Mass. I would like to know if anybody here can tell us of any other case besides that, in the last 10 years.

THE PRESIDENT—Not probably an accomplished fact but they are threatening it.

MR. BUTTERWORTH—They are talking about it, but I think the question of electric street lighting is more thought of in this connection, possibly because the public seem to think that gas is a back number. People don't think so much about the municipal ownership of gas works as of electric lighting plants. I think the gist of Mr. Boardman's paper is in the last paragraph, where he says that the only cities that can with any degree of consistency undertake to conduct a lighting plant are those in which all the other branches of their city governments are already being perfectly administered. I often think of a conversation that my former associate, Mr. Lathrop, and I had one day with a certain leading gentleman of the city of Columbus, O., who was advocating municipal ownership. He is a sort of politician, a large manufacturer, a man of large affairs in that community. We went to him to call him down a bit; to have a little private talk

with him. We said, "The city is not doing well in the business it is now undertaking to do; why should you talk of taking on these other difficult and technical matters, under such circumstances? Look at our water works. Our city water is notoriously unfit to drink. Look at our streets; they are dirty and full of holes. The work the city is now undertaking to do is very poorly done, yet you talk of taking on more! Do you expect the city to do any better with gas works and electric light works than with its water works?" He said, "Well, I admit they are pretty bad; but when we give the city officials and our governing bodies more responsibilities they will rise to them." We said, "Do you do that way in your own manufacturing establishment? When you find an employee who does his work poorly, do you promote him, so that he may rise to the added responsibility?" He said: "No; he promoted the competent men and discharged the incompetent men." In this connection I often think of the parable wherein certain men were charged with certain responsibilities and given certain opportunities, to which some of them rose more or less successfully, and the successful man, who had made most of his opportunities, was told, "Well done, good and faithful servant, thou hath been faithful over a few things, I will make thee ruler over many things; enter thou into the joy of thy Lord." Suppose the Master had said to the man who had made a failure, "Badly done, incompetent and unreliable servant; thou hast been unfaithful over a few things, I will make thee ruler over many things!" How inconsistent and unjust that would have been! And yet that is exactly what the advocates of municipal ownership are saying to American cities to-day.

MR. ENRIGHT—I can hardly agree with the writer of this paper on the idea of municipal ownership growing in popularity; for, as a matter of fact, as far as my experience and observation go, it has been declining and gradually growing into disfavor with a very large class of the intelligent, honest, thinking people during the past year. Now, as an illustration, I wish to call your attention to what happened at Kansas City about 6 months ago, at which time the people of that city were called upon to vote on a proposition to bond themselves for $400,000, to be used in the construction of a municipal electric light plant. The election came off in due time, and to the very great surprise of

those who favored the measure, they woke up the next morning and found themselves overwhelmingly defeated. And you, no doubt, would like to know how this result was accomplished. As soon as this scheme was laid before the people of that city, the Kansas City *Star* sent forth an able corps of reporters, and those men ran down the exact condition of every municipal plant within a radius of 200 miles of that town, and their reports showed, which included taxation, cost of street lighting, as compared with what they formerly paid to private companies, their increase in taxation as well as their great loss in commercial lighting wherever it was undertaken. In one instance they clearly demonstrated where 95 per cent. of the community were being taxed to make up the loss of current sold at much less than cost to owners of palatial homes, large hotels and business houses of the place, and such plain, matter-of-fact data appeared daily in the *Star* during the campaign and was backed up by very able and convincing editorials. This work will enable you to see the great power and influence wielded by an honest, able and conscientious newspaper, one that has the interest of its community at heart and the moral courage to defend them. And should such a man live in your town, all that is necessary for you to do is to show him the fallacy of this doctrine and you will find him and his paper opposing such undertakings. Strange as it may seem, about two-thirds of the time devoted to this subject in almost every case is taken up by the question of ownership of public utilities and the many great advantages derived therefrom, where, as a matter of fact, there is very little in the ownership of any property; for instance, a little child could own this magnificent hotel or the great Pennsylvania Railway system, and as long as the properties remained in the hands of the present or some equally good management, they would be successful. So do not throw away your time combatting the question of ownership, for in doing so you generally succeed in bringing down a mountain of prejudice upon your heads. It is far better to devote your time to showing the taxpayers, the people who contain public justice in their makeup, and those who have a desire to be honest with themselves as well as the community in which they live, that, owing to our form of municipal government, it is almost impossible for a municipality to manage properties of this kind in the interest of the people—

that, on the contrary, it will be to their detriment. You can also quote a legion of cities and towns in our country where this scheme has failed that will successfully back up your statements. Also, clearly show them that "what is everybody's business is nobody's business." Do not fail to try to convince the great industrial class, those who own the many little homes in your city, that it is a great mistake for them to mortgage their property to carry on political schemes of this kind, for if they do their property is very liable to be taxed, in case commercial lighting is done, to make up the loss in lighting the homes of the wealthy, while they sit by a gas light, coal-oil lamp or candle which they pay for themselves. In conclusion, I desire to state that our experience in this line within the past 4 years has covered almost every phase of this question, and I should like to relate it from its introduction in our towns, having the city as a competitor, their efforts to force us out of the field (and, by the way, let me state that as a general proposition a municipality as a competitor in the lighting business is a snap as compared with a well handled plant owned by private parties), our legal contests with them, not to mention the many amusing things that have happened. However, the all-important thing for a community to learn is to be honest with themselves, to conduct their public affairs on the same principles that are always applied to private undertakings. This, I am free to admit, is very seldom done by municipalities; but wherever you find a citizen who believes in that sort of public management, you will also find a man who is willing to encourage capital as well as work for the welfare of his town and people. Such a man is intelligent enough to be honest with himself, and I would rather have 100 such men than 4,000 who did not know enough to be honest with themselves or the city they call their home.

MR. BERKLEY—In the discussion of this subject I desire to call your attention to a case of municipal ownership that shows the usual efficiency attendant upon such business relations between the municipality and the people. In the State of Ohio there existed an artificial gas plant. Natural gas being discovered private parties engaged in the business, after which some of the city officials incubated the idea of municipal ownership and cheap gas. Things went smoothly until the gas began to fail, and when nature failed the city authorities' resources failed.

However, a young lawyer at the time saw the opportunity where money was being lost; he saw that two shares of stock could be made to grow where before one or less grew. His proposition was finally accepted, and from junk, including lines in size from 12 to 2-inch, which were of no use to the system were taken up, and together with the surplus of other good or better material purchased by the city were sold for a large sum of money. Subsequent sales of junk reduced the cost of the plant to almost nothing, as $150,000 was the purchase price as compared with an expenditure of nearly 1 million. Natural gas has so decreased that we are now installing for the present owners an artificial works with a capacity of three-quarter millions daily, thus we have a fair sample of the management by municipal ownership. I think the last sentence of the paper by Mr. Somerville could be incorporated in this discussion with much profit, for to that class of exuberant gaseous gas men belong the responsibility of helping to hatch out municipal ownership, through the incubator of a city council. Tinhorn politicians and political ward healers who are easily caught by such statements, as we get 11,000 to 11,500 cubic feet of gas, current price $1.25, 1,400 to 1,500 pounds of coke and tar and ammonia enough to make such a showing that, when compared with the cost of one ton of coal at market price, the gas company is at once cited as a monopoly and robbing the citizens. Young men of the profession, use consideration, moderation and correct statements. If you are getting such grand results let the balance side of your ledger keep silent sentry on your achievements.

MR. HARBISON—I have listened with much attention and care to the paper and discussion on this matter of municipal ownership. Much has been thought of and written in connection with it. It is a sort of fad or craze that is going around the country, this idea of municipal ownership. In our city of Hartford we have a very large amount of talk, gush and nonsense brought forth on the subject of municipal ownership. Our State (Connecticut) has five or six, so called, labor representative Mayors of its principal cities, and they are all, of course, interested in this question of municipal ownership. The Mayors have quarterly meetings in which they sit together and talk about it, and dine and wine at the expense of the resident Mayor, and municipal ownership gets quite a boom at these

meetings. We have attempted legislation on the subject, and they, of course, were in favor of it. Much has been said in regard to the press and its influence and all that sort of thing, but the press generally is fair minded and honorable, and desires to have the right thing laid before its constituents. The readers are its constituents, and I have failed to find a paper (that was not of the yellow journal style) that was not willing and glad to get reliable data and information on this subject. They have no wish to mislead the public, they cannot afford to do so, and the duty of every gas man is to see that every item of information that comes to him on that subject, that is truthful and reliable, is conveyed to the editor of the paper or papers in his immediate vicinity. Lay the matter before the editor, and leave it on his honor and duty as to what he shall do regarding it. The results will not be disappointing to you. I speak with some knowledge of the situation. In our city of Hartford, of 82,000 people, at the present time we have a Mayor, coming from behind the counter in a ready made clothing establishment, to be Mayor of a city at $3,000 a year at one jump, a bright man, deeply interested in the co-called labor element experiment, and, of course, imbued clear through with the value of municipal ownership, the value of public utilities for the city of Hartford; and in season and out of season, day and night since his election, he has been devoting much time to that subject, appearing before committees and organizations, reading papers to business men of the city on that subject, and immediately after finishing his reading taking his hat and coat and leaving the room apparently afraid of being asked questions. A committee of the Common Council was appointed last year on this subject, who subsequently reported unanimously against the feasibility of it. That report was laid on the table near the close of the old Council year, and taken up immediately after the new Council came in, when its further consideration was indefinitely postponed. That will be the result which each one of you will experience if you will take hold of it right. Put a word of good advice and good counsel in the ears of the committee; he may be waiting on you to get facts, that they want to know. To begin with we have a law on the statute books of our State which says that any town or city, before they can go into the business of supplying gas, must first treat with the old company, buy out its property and carry that on. So the

esteemed Mayor and supporters, in order to arrive at municipal ownership, must buy out the existing gas works. The gas companies have nothing to do but to say we will accept; then name their price. If the city is not willing to accept it the law provides that a commission shall be appointed by the courts, of three disinterested parties, and they to make an award that the city is bound to pay, and now in one city they are trying to show that the law is unconstitutional, and they will not be compelled to take the burden. They are in a bad fix. This municipal ownership business; what will they do with it, if they get it? Tell me a city in this country where there is a man competent to manage a gas works except the men that are engaged in the business already. I tell you, gentlemen, there is a whole lots of truth right in there. Of the thousands of men in the city where you live the only one competent to carry on the business you are carrying on is yourself personally, and they all know it. What can they do? They cannot afford a man from the next town; they cannot get him, he is needed there. That is our experience in trying to get good help. Municipal ownership can be killed if the gas managers manage that feature of it judiciously, with good common sense. Treat your customers well, give them good service as they are entitled to, as you are accustomed to do, maintain your good reputation, and how can they better themselves? The people that own stock in your gas companies are not coming in to throw away their investments and increase their taxes for municipal ownership, which will carry with it increased expenditures beyond those now in force; and it cannot be otherwise. Politicians get hold and control, and they will get hold and control, and we know what that means in any city where matters are run politically. There is no greater field for politicians to enter if they can but get towns that have the management and control of the gas industry. We have it within our hands to hold on to it, and so carry on our business that no power can take it from us or will be willing to, and we have done our duty to our own reputation, and to those who are stockholders in our enterprise, and to the people whom we serve. (Applause.)

MR. D. MCDONALD—There was once a very successful man in New York named Jay Gould, and there was once a movement on Wall street, when a reporter came to him and said, "Mr. Gould, do

you think this movement can be stemmed?" He said, "My friend, I never attempt to stem any currents. I simply find out which way they are going and either make them go my way or go with them." If there is in the United States a popular current in this connection, the gas men cannot resist it. In fact we can exercise less than our ordinary influence as citizens because whatever we do will be supposed to come from interested motives. I think we can, however, so shape matters that if the city insists on having a gas plant they will pay a fair price to those who are stockholders for it. Mr. Boardman's excellent paper points the way. If the cities of this country do not get hold of the gas business until they have thoroughly mastered the sewer business, and the murder business (by that I mean punishment of murder), and keeping streets clean, when they get that highly educated, the public conscience will also be educated up to a point where they will either be unwilling to touch the gas works, or else will be willing to pay a fair price for it. The courts, both State and national, stand against property being taken for public purposes without compensation, and in cases that are left to a commissioner of a court as to what property is worth, as a general proposition the private owner does not get the worst of it as against the public.

REPORT OF COMMITTEE ON WORLD'S FAIR EXHIBITION.

THE PRESIDENT—We are ready to receive the report of the Committee on World's Fair Exhibition.

MR. MILLER—Mr. President, this Fair Committee consists of Mr. Chollar as Chairman, myself and Mr. Mitchell. I have not had any consultation with either Mr. Mitchell or Mr. Chollar. I don't believe Mr. Mitchell has done anything. I know I have not, and Mr. Chollar says he has not. I think, however, we are right at the point where if any sort of action is going to be taken or Exhibition given it should be put into shape now. The management of the affairs of the Association seems to be pretty much in the hands of the President; it might be put in such shape that the President can take such action as the case seems to demand.

THE PRESIDENT—Gentlemen, you have heard the report of

the Committee, which indicates that it will be proper to have a resolution placing this matter entirely in the hands of the incoming President, or in his discretion.

MR. D. MCDONALD—I have the greatest confidence in our President, but it seems to me for the Association to say they will place this matter in the hands entirely of the President, and be bound by whatever he does, without confining anything, how much money is to be spent, or if any is to be spent, or even learning what is to be done, looks to me a bad precedent.

MR. SHELTON—Perhaps I can best answer that by giving an idea of what little has taken shape in a small degree in the discussion of this subject in so far as I have been able to gather it. I will try to do it briefly. I am more or less responsible as President—at least I will be next year—for what the Western Association does at the St. Louis Exposition. You know these expositions always raise great big questions. There was a great amount of experience accumulated in that question in regard to the Chicago Exposition. As to the Association taking any part or trying to make an exhibit, there seems to be insuperable obstacles; that is, to do it successfully. It means a great amount of labor and a great amount of knowledge on the part of someone, trying to line up different interests together; it means the expenditure of a very large amount of money. It means something which was a failure to successfully put through at the Chicago Exposition in 1893. The unanimous sentiment, as far as I have been able to ascertain, is that it will be a mistake and unnecessary for this Association to try to make an exhibit, unless it be an historical exhibit, at the St. Louis Exposition. If any movement of that kind should arise it should naturally come from people who have goods to show; it is not the province of an Association. This fact, however, was suggested: The St. Louis Exposition is peculiarly a mid-country enterprise. It is in the great central territory that this Association covers. This Association has elected to go there the coming year. It can most appropriately act as host to such visiting gas men as may come to the Exposition, no matter what Association they come from—the New England, the Pacific or any other Association. The Western can stand at the center of the Mississippi Valley and extend its hand of welcome in any shape it may see fit, extend facilities for comfort, have a point where gas men can

gather. It would be a nice thing for the Western Association to stand sponsor for and to do. It would not take a large amount of money to arrange for headquarters within the grounds if feasible, or without the grounds if necessary—in the grounds preferably, a sort of gas men's club, you might say, for 6 months in the city of St. Louis. The expense involved in that would not be so great; possibly the larger gas and supply companies might come in and raise a little money without involving this Association in any Association action or levying an assessment. It is just as much my duty as President to see that the Association is not unduly put to expense, as any other duty I have to perform that year. The tendency seems to be to try (if possible by local committee that may be appointed) to provide a modest headquarters for visiting gas men, under the auspices of the Western Association. On that line I would like your authority to work. I don't know that it is possible (there are a great many questions arise at once), but I think it would be a nice thing to do, and a number of people with whom I have spoken seem to agree that it would be a desirable thing. If it is the sentiment of this Association that the President try to go forward on those lines with such a committee, those will be the lines on which I would expect to work, without undertaking any trade exhibit feature, without undertaking any expense feature of any kind for this Association. That committee would have to be part local and part up-and-down the valley, and I would suggest that the appointment of that committee be left to the incoming President. That is as far as anything I have been able to take up looking ahead to next year.

MR. D. MCDONALD—The suggestion Mr. Shelton makes is the best one I have heard, but as far as I am concerned I do not think the end will justify the means, especially if the means are that the supply men shall be expected to put up some money to entertain us. I move that it is the sense of this Association that we take no action at all as to the St. Louis Exposition.

MR. HARBISON—I hope my friend's motion will not prevail.

MR. D. MCDONALD—It has not received a second.

MR. HARBISON—I will second it for the sake of seeing it fail.

MR. D. MCDONALD—I withdraw the motion.

MR. HARBISON—Mr. President and Gentlemen, I believe in what the President-elect has said. We are an industry and we

have a pretty decided competitor in the electric light industry, and they will not spare time nor money to make an exhibit at St. Louis that will boom their business. I do not think it necessary for this Association to appropriate money, to go to any expense to amount to anything for the purpose of having an exhibit of gas appliances in the city of St. Louis at that great fair we are looking forward to; but I do think it is due to ourselves, to our profession and the industry that it should not be a back number. A committee with the President and his associates would see that space was provided, and that those who are in the manufacturing of appliances connected with the use of illuminating gas have a place in which to exhibit their wares and show what can be done, and that is what we all want to have done in St. Louis, where every man, woman and child that can, from all over the country, will visit to see what there is there on exhibition, and see what advancement has been made in various lines. I think the gas industry ought not to be a back number, and with the energy and push of our President-elect and such associates as he may call into counsel with him, they will be able to get an exhibition there that will be of great credit and advantage to our industry, and without expense to the Western Gas Association. Every manufacturer of gas appliances will only be too glad to get space there in which to show his wares and prove that they are the best made in the world, and so will his competitors. We ought to give them the opportunity, and hope the resolution that the President and such associates as he may call in with him should co-operate to that end, and yet without burdening this Association with money expense, will prevail. I hope, therefore, that authority will be given the President, and that we shall expect of him, as we always look for, excellent results in work that he undertakes, and we have a good right to from what he has done, and that this will not be an exception to his previous history.

THE PRESIDENT—Those in favor of adopting the report of the committee will make it known by saying aye. [The motion was carried.]

At the request of Mr. F. H. Shelton, the following paper, written by him on

QUADRUPLING THE CAPACITY OF AN ORDINARY PURIFIER HOUSE AT VERY SMALL COST,

was taken as read:

Small companies are often confronted with the question of the need of considerable increase of purifier capacity, in conjunction with but a small amount of money with which to enlarge. I suggest the following method as a simple and effective procedure. It is based on the very satisfactory use of concrete for making home-made boxes at half of the usual cost, as recently done by the New Orleans Lighting Company, in a set of 4 purifiers, 25 feet square by 7 feet deep each, and described by me in a paper, entitled, "Current Purifier Practice, and a New Form of Construction," read before this Association at its meeting in May last.

A purifier box is, after all, but a rectangular vessel to hold lime or oxide. A vessel that is outgrown needs to be replaced by a larger vessel. The method herewith proposed is that of using the purifying house or cellar itself as a vessel for holding, preferably oxide. The scheme can best be shown by describing the arrangement at Petersburg, Va., where I am now carrying it out. Sketch No. 1 shows the existing purifiers 55 feet by 10 feet each by three feet deep, with the usual center seal and connections, inclosed in a room 26 feet 4 inches wide by 32 feet 2 inches long. The cellar is 8 feet deep from floor to floor, and there is comfortable (19 feet) headroom to the roof trusses. The arrangement is representative of sources of small purifying houses. The 4 boxes proper together have a cubic capacity of 600 feet; the capacity of the cellar space from floor to floor level is 6,656 cubic feet, or 11⅓ times that of the boxes. It will readily be seen that if the cellar is made into the holding vessel how great a gain of purifying space can be secured.

Sketch No. 2 shows the plan underway. The walls are lined with concrete a few inches thick to make them perfectly water tight, and to give a smooth interior surface and to take up the irregularities of the stone work. Expanded metal is imbedded in this concrete to bond everything together. The cellar floor is filled in and leveled off in the same manner with about a foot of concrete, leaving a 7-foot space to the main floor line. The concrete floor should be not quite level but should drain to one corner, at

1. See Journal, June 9, 1902; p. 887.

which point a 4-inch tar pipe connection should be supplied. Across the building two walls, *AA*, are run from floor to floor between which about 6 feet space is left for pipe connections. Further walls, *BB*, are constructed to subdivide, the result being 4 boxes, each 12 feet wide by 12 feet long by 7 feet deep. These boxes with concrete walls properly made will be found entirely water tight and probably gas tight. If any doubt exists on the latter point the walls can be further treated by a coating of hot paraffine, applied on the inside to fill the pores. These boxes are fitted with tee iron tray, bearing bars at convenient levels for carrying 2 deep beds of oxide. These tee irons are carried on small cast iron brackets that are bolted to and through the walls. The gas enters between the two beds of oxide, one-half of the stream passing up and the other half passing down, the two streams uniting in a collecting take-off pipe located against the walls, *AA*. The covers are of the dry-lute pattern, made of ¼-inch wrought iron plate, stiffened with 3-inch angle iron, riveted all around the under edge and by 3 tee irons riveted across the top. The gas tight joint is made by a 1¼-inch rubber buggy-tire, cemented to the under side, around the four edges of each cover. When the lid is lowered, this rubber rests on a 6-inch channel iron imbedded in the concrete walls and forming the top and wearing edge of the box. At intervals of about 20 inches all around this angle iron, upright 1-inch bolts project, that are imbedded in the cement and carry swivel cams or dogs for locking by a wedge action and holding down the covers. When the lid is to be raised, the cams are all freed by turning a quarter circle and the cover can be hoisted clear. The covers are lifted from the old I beams overhead used for the original covers. The valve connections controlling the supply to each box are conveniently located and handled between the walls *AA*, and this space is floored over above, with any kind of open wood slat or iron plate flooring that is desired. When everything is closed down, and the boxes are in use, the floor lids and the flooring between the walls *AA* form, practically, a level floor over the area of the whole room, and at the same level as the old floor and the ground level outside. In cases where the old floor is 3 or 4 ins above the ground level, the new floor would work out to the same level, and the cellar floor or box bottoms would be that much nearer the ground level, and all the better.

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When a box is to be opened, the lid is hoisted a foot or so, and pushed along out of the way, over an adjoining box. It is proposed to remove the oxide by having a large wrought iron dumping bucket carried on an overhead light track or rail (shown by the light line) extending, over all of the boxes and running outside to any desired point, for dumping the oxide. This bucket, holding several bushels, will be carried on a light chain block and fall, so that when filled at the bottom of the 7-foot box, it can easily be hoisted up 7 or 8 feet for clearing the box, and then be pushed out on the overhead trolley rail.

At Petersburg the result of above is cubic space for purifying about 6¾ times greater than in the old boxes. It would be an exceptional case that did not result in at least three or four times more capacity. Moreover, as the gas is subdivided into several streams, and each stream in turn is subdivided into halves passing through each layer of oxide in each box, the rate of flow is desirably very slow, the proportionate area of surface and time of contact being greatly increased.

The plan permits of the use of the existing house without any change whatever; it disarranges nothing on the premises; involves no more yard room and but little change of general pipe connections; it utilizes the old beams and hoists of the cover lifts; it does away with water seals, rusted purifier sides and blowing cups. The work, moreover, can be done comparatively easy by the company itself with a little care, enabling much quicker completion than the usual delivery from shops at a distance, where a good deal of iron work is involved and the cost is undoubtedly much less than that for which the same results and capacity could be secured if new purifiers of the usual form be contracted for.

In brief, is there any reason in many cases why the purifier house itself should not be made water tight, and be used as the oxide holding vessel, giving enormous increase of capacity in a simple and inexpensive manner? In some cases no doubt one half of the purifier room fitted in the above manner would give enough new capacity, leaving the other half for convenient use for oxide, by flooring over with a course of brick grouted in cement.

On motion, a unanimous rising vote of thanks was tendered Mr. Shelton for preparing the paper.

THE QUESTION BOX.

The Secretary reported that the Question Box held only the following inquiry.

What is the best plan for reviving a man overcome by artificial gas; and what is the best treatment for one partially overcome?

A MEMBER—Plunge them in cold water containing plenty of hartshorn. .

MR. MILLER—I have gone into that thing pretty extensively. Talking with our physician over the subject, his idea of the best thing to do is to bring about respiration by artificial means. Throw the patient on his back, raise his shoulders so the head will fall back and give free passage to the air; pull the arms back, then down on the chest and press hard, with about the rythm of breathing, until respiration is restored. As soon as respiration is about normal again, the heart action not yet being normal, a very good thing is to let the sufferer inhale a little nitrate of amyl, which distends the blood vessels, giving them a chance to pass more freely through the veins and arteries. Immediately on placing a rag saturated with nitrate of amyl in front of the patient's nose, almost instantly (or in a few seconds) the patient will be suffused, the blood will be seen flowing more freely. If they have inhaled too much carbon monoxide they will die; there is absolutely no way to eliminate it if it is in too large a dose. The blood is so fixed that the red corpuscles cannot give up their oxygen, and the blue corpuscles, are the ones charged with carbonic acid, cannot give up the carbonic acid and take the oxygen again. I know of a case, one out of three or four recorded, in which the patient did not die within a few hours. He lived 13 days before death ensued, and on the fourth or fifth day a spectroscopic analysis of the blood showed carbon monoxide still therein.

MR. JOHN D. MCILHENNY—The question is especially asked with reference to water gas. I would say in the University of Pennsylvania a few years ago, some very careful tests were made particularly upon animals, to find out by what means restoration could be effected. It was conclusively shown that if in sufficient time fresh blood could be supplied to the patient (in other words, by transfusion of fresh blood) the patient would recover. In fact, the result of the researches was to show that in no other

way could the patient be restored from poisoning by carbon monoxide except by transfusion. They made quite a number of tests on dogs, and in every case in which fresh blood was supplied, before the sufferer had gotten beyond a certain stage, it recovered.

MR. D. MCDONALD—There are not many service gangs that carry along appliances for the operation of transfusion of blood, and not even many of them are armed with nitrate of amyl, but you will find that certain doctors will tell you to take a man into the open air and walk him up and down, while others will tell you that will kill him, advising instead to lay the affected one down and keep him where it is warm. Others will say give him whiskey. Others will say give him a little coffee. Now, there are three or four treatments, all of which I have known to be applied, which are founded on directly contrary principles. It is a pretty important matter that we should not only know this thing, but know it in a way to have it handy at the time, and I am going to move that the incoming President appoint at his leisure a committee to look into this matter, and to have printed in card form complete directions by which workmen can restore one another where that is possible, and whatever information can be added beyond that, if that should be impossible. If a man keels over in a ditch there is no time to make any transfusion of blood, to administer pure oxygen or nitrate of amyl. You have to do something right there and then.

MR. DOTY—I desire to put upon the record my approval of what Mr. Miller has said as a first aid to the injured. I think, however, he should have gone a little further, and have an arrangement made with the doctor so that the injured man can be taken to the hospital as soon as possible where oxygen tanks are constantly maintained for producing artificial respiration. If any of our men are overcome, they are sent to the hospital as soon as possible, and when they reach there the oxygen is ready and artificial respiration by the use of pure oxygen can be carried out. Men that have been almost completely gone have completely recovered by the use of this artificial oxygen. The use of ordinary stimulants such as whiskey, and other means of that kind involving the putting of something into the stomach is absolutely prohibited by eminent authorities. The only thing to do is to re-vitalize the blood, and that must be secured by respiration. It

is not difficult to have some arrangement with an established hospital that will have an oxygen tank ready so that the moment a man reaches there the work of recovery can begin. It is also quite important that some arrangement be made with a reputable physician, who will be known as the company's surgeon, and be in the company's employ on an annual payment or an established fee, so that the men themselves will know to whom to telephone. All of our men have cards given to them showing to whom they can immediately telephone, and likewise telephone to the hospital if necessary.

MR. PERKINS—I want to verify what Mr. Doty says about the use of oxygen. We have used it in many cases and have had complete recoveries in a short time. As I understand it, a man might die from carbon monoxide blood poisoning due to lack of circulation caused by the carbon monoxide changing the shape of the blood corpuscles so that they cannot flow or circulate. As Mr. Doty says, treatment has to be applied for the aeration of the blood through the lungs. Anything administered through the stomach is both useless and dangerous.

MR. D. MCDONALD—As a matter of fact I found two doctors in our own city, one of whom actually administered a certain treatment that the other doctor said it was a great wonder it did not kill the man. Now, the truth is somewhere, and it is not hard to find the most portable and applied remedy. The remedy to send to the hospital where there is a tank of oxygen, of course, is probably best, but there are many small towns where there is no hospital and where there would be no tank of oxygen.

MR. HARBISON—If we go on with this discussion providing for these remedies, it will be set down that the gas managers are a set of highway murderers. That we are to set up a drug store in our wagons, build hospitals, hire physicians to take care of those who are injured, I think is all unnecessary, in our experience, and we have had our share of it; we have had many people working for us whom I knew had inhaled too much gas. My experience is that the wisest thing to do is to have in your wagon under the care of your foreman, whether at mains or service pipes, a nice little bag of juicy apples or a dozen lemons, and before a man goes to tap a gas pipe give him an apple or a lemon and send him over by the fence to eat it. You will not have a

man overcome next year by using just that little precaution. That is our personal experience repeated many, many times, and we have never killed a man, and we don't have a corps of physicians on our pay roll, and we are not supporting the hospitals to take care of our patients. We have also given them some good strong coffee and bathed their heads in plenty of cold water. If my plan is followed there will be no trouble from illuminating gas which they will inhale, they won't inhale much of it. I think it is the duty of every manager in these days to use every precaution in advance. If I have a large service pipe to tap, and we don't tap less than 1¼-inch hole in any pipe, I put in a stopper each side of the work to shut off the flow of gas. It is a very inexpensive matter, and there are stoppers that are very effectual.

MR. D. MCDONALD—This question has brought out the information which it was desired to bring out, and if apples and lemons are really the best things, I would like to have official approval of the Association on the apple-and-lemon idea. Therefore, I want to renew my motion that a committee be appointed to investigate this and print the findings in card form so as to be posted for ready reference.

MR. GIMPER—We had a man overcome last November while making a 6 and 8-inch connection. Two gas bags gave way. We had no time, as Mr. Harbison suggested, to give the men apples and lemons to eat; but we sent for a doctor. The man had fallen into the ditch. We got him out promptly, got him into fresh air, fanning him till the doctor came. The doctor found the patient's pulse low. The first thing he did was to give him a hypodermic injection of strychnine which revived his heart action and he soon was breathing stronger again. The man claimed to have suffered great injury. His shoulder was so lame he could not raise his arm. He also claimed his eyesight was injured so he had to wear glasses, one for near and the other for farsightedness; also, his chest was affected from the gas, and the X-ray machine showed dislocation of the shoulder, for all of which he only wanted $10,000, but he recovered very fast after a compromise was made with him. The hypodermic injection and fresh air were very beneficial in this case.

MR. SHELTON—I think before a motion to adjourn is put to reconvene tomorrow, it is only proper that an expression of our

appreciation and thanks be given to the men who have provided for our entertainment here, for all the courtesies extended to the members and friends of this convention held in Indianapolis. We have been beholden to them for a great many kindnesses; a great many courtesies, and for practically taking care of us. I think it would be extremely proper that this Association express its thorough appreciation of the work done by the Committee of Arrangements and by the local gentlemen of the Gas Company, and those who have participated in making arrangements for us. We know we have been well taken care of; we know that blemishes of service in a new hotel were not the fault of the local gas people, or by intent, but of conditions beyond their control. We appreciate the sincerity, the intent, the desire on the part of the local committee to give us the best they possibly could; they have done it, and I am sure we appreciate it, and I move that the Association take this occasion to express its thanks.

The motion being seconded was unanimously carried by a rising vote.

On motion of Mr. William McDonald the thanks of the Association were tendered, by a unanimous rising vote, to the President and Secretary of the Association for their careful, earnest work at the meeting.

A motion to declare the Convention adjourned was adopted.

PROCEEDINGS

— OF THE —

WESTERN GAS ASSOCIATION

TWENTY-SEVENTH ANNUAL MEETING

— HELD AT —

ST. LOUIS, MO.

JUNE 14, 1904.

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OFFICERS

OF THE

WESTERN GAS ASSOCIATION

1903-1904.

President.

F. H. SHELTON..... Philadelphia, Pa.

First Vice President.

O. O. THWING.....St. Louis, Mo.

Second Vice President.

PAUL DOTY.....Denver, Col.

Secretary-Treasurer.

JAMES W. DUNBAR..... New Albany, Ind.

Editor Wrinkle Department.

WM. E. STEINWEDELL..... Cleveland, Ohio.

DIRECTORS.

A. H. BARRET.....	Louisville, Ky.	*Ex-Officio.*	
JAMES SOMERVILLE	Indianapolis, Ind.	Term Expires	1904
ROBERT YOUNG, JR.....	Pittsburg, Pa.....	" "	1904
GEORGE S. CLARKE.....	Kansas City, Mo...	" "	1904
D. R. WARMINGTON.....	Cleveland, Ohio....	" "	1904
WILLIAM MCDONALD....	Albany, N. Y.....	" "	1905
T. D. MILLER	New Orleans, La...	" "	1905
JOHN D. MCILHENNY....	Philadelphia, Pa...	" "	1905
K. M. MITCHELL	St. Joseph, Mo.....	" "	1905

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PROCEEDINGS

—OF THE—

WESTERN GAS ASSOCIATION.

TWENTY-SEVENTH ANNUAL MEETING

— HELD IN —

HALL OF CONGRESS, ADMINISTRATION BUILDING,
LOUISIANA PURCHASE EXPOSITION,
ST. LOUIS, MO.

June 14th, 1904.

MORNING SESSION.

The meeting was called to order by the President, Mr. F. H. Shelton, at 10:40 A. M., of June 14th. Secretary Dunbar announced the regular order of business, and the President recited the several items, action on which was taken as follows: The roll call was deferred, the reading of the minutes of the last meeting was dispensed with, and the report of the committee regarding the election of new members was also deferred.

The President called for the

REPORT OF THE BOARD OF DIRECTORS,

which Secretary Dunbar read as follows:

The annual meeting of the Board of Directors of the Western Gas Association was held in the Hotel Jefferson, at 2 P. M., Monday, June 13th, Mr. F. H. Shelton presiding. The following members were present: F. H. Shelton, O. O. Thwing, Paul Doty, John D. McIlhenny, Wm. McDonald, D. R. Warmington, Geo. S. Clarke and Thos. D. Miller.

On motion of Mr. Warmington the following papers were accepted for presentation to the Association:

"Low Candle Power Gas," by Capt. Wm. Henry White.

"Coal Projectors," by Mr. F. H. Shelton.

"Wrinkle Department," edited by Mr. Wm. E. Steinwedell.

The following committees were appointed:

Auditing—Messrs. F. H. Shelton, George S. Clarke and John D. McIlhenny.

On Memorials—Mr. Paul Doty.

On Membership—Messrs. Wm. McDonald, Thos. D. Miller, D. R. Warmington.

The action of the President and Secretary was confirmed in selecting distinguishing badges to be worn as follows: Honorary members, white enamel letters; President and Past-Presidents, blue enamel letters; Secretary, green enamel letters; Membership, as at present, red enamel letters.

The secretary was authorized to exchange Honorary and Past-President's badges for those they now have.

On motion of Mr. George S. Clarke, the Board extended a vote of thanks to Mr. O. O. Thwing, appreciative of his labors in editing the 4th volume of proceedings, for the years 1898 to 1902, inclusive, recently published. On motion of Mr. Dunbar, the officers of the Association were directed to acknowledge the thanks of the Western Gas Association to gas companies contributing financial aid in meeting the expense of the gas exhibit at the Exhibition.

It was ordered that each three months the Secretary send to members a list of volumes contained in the Thompson Memorial Library, calling their attention to the privileges afforded, and soliciting additional contributions.

On motion of Mr. Doty, a unanimous vote of thanks was extended to Mr. Shelton for his efforts and energies in inaugurating and maintaining the gas exhibit in the Liberal Arts Building.

Mr. Thwing moved the appointing of a committee to draft suitable resolutions expressive of the Association's appreciation of Mr. Shelton's labors and success in having successfully projected the exhibit of the Western Gas Association.

REPORTS OF SECRETARY AND TREASURER.

As Treasurer, Mr. Dunbar submitted his report, showing that the receipts for the year to May 1, 1904, were $2,932.45, that the expenditures had been $1,936.35, and that the cash balance was $996.10. As Secretary, Mr. Dunbar reports as follows:

Membership, May 1, 1903		377
Admitted during 26th Annual Meeting	38	
Reinstated during year	2	40
		417
Died during year	3	
Resigned	9	
Dropped for non-payment of dues	6	18
Membership, May 1, 1904		399
Badges on hand May 1, 1903		16
Sold during year		10
On hand May 1, 1904		6

On motion, the Directors' meeting was declared adjourned.

On motion, the report was received, adopted and placed on file.

THE PRESIDENT—A subject which it was decided yesterday to put to a vote of the members is as to whether it would be better to have a single session and dispose of our work without adjourning until we adjourn this afternoon, or whether we shall reconvene after the lunch hour. There are expressions of opinion favoring both plans, and it seems to be the more practical plan to decide by popular vote as to which will be preferable. If we stay in continuous session it will probably be 3 o'clock before we get through—perhaps half past. We may get pretty hungry by that time, and the attendance is apt to thin out towards the rear end of such session in diametrical proportions to our augmenting appetites, as I have found by experience. If we adjourn at 12:30 or 1 and take an hour for luncheon, which we can get on the grounds, and reconvene promptly, say at 2 o'clock, we can then take 2½ to 3 hours, adjourning between 4 and 5, with probably a good degree of comfort. Both plans have been suggested, and the Chair proposes to leave to a vote of the floor as to which plan shall be adopted after conference on the suggestion.

Mr. Somerville moved a recess at 12:30 for an hour. (Seconded.)

THE PRESIDENT—Are there any who desire to stay in continuous session from now until 3 P. M.

MR. FORSTALL—If that resolution is passed, I suppose it is understood that every man here pledges himself to come back.

THE PRESIDENT—I think the rider to the resolution is the best part of it; it should be lived up to. We have compressed our meeting into one day this year because of the local condition (the Gas Congress), so I think it is up to us to be good and pay attention to business to-day, enjoying ourselves during the balance of the week.

MR. NORRIS—There must be a good many who have made arrangements to spend the afternoon otherwise than here, so there must be a good many who can not do as Mr. Forstall says; but I hope everyone will try to come to the afternoon session if this motion be passed. If I understand it, this motion is in favor of two sessions, those voting aye vote in favor of two sessions.

THE PRESIDENT—As the Chair understands, Mr. Somerville moves that we adjourn about 12:30 for an hour's recess. I should suggest that we reconvene at 2 o'clock sharp. It will take over an hour to have luncheon and get back to the hall. The Chair in presenting the motion does it on the basis of adjourning at about 12:30, reconvening at 2 P. M. for the second session, and continuing this afternoon as far as our business session is concerned.

A vote was taken upon Mr. Somerville's motion, which was declared carried.

NEXT PLACE OF MEETING.

THE PRESIDENT—Another matter that may be disposed of at the moment and save a little time is the place of the next meeting. It is customary to appoint a committee on place of next meeting, who duly consider the matter and report later in the day. The Chair is entirely willing to conform to the custom if desired, but I have happened to run across quite a sentiment for going to Chicago next year. At least 8 or 10 have spoken of it. It is several years since we have been in Chicago, and I think there is quite a sentiment for meeting in the central portion of the country this ensuing year, as we have been a long distance, to Chattanooga and New Orleans, in the comparatively recent past; and as I have found no other suggestion as to any other place than Chicago, and a good, strong sentiment in favor of that

place, it seems to me it may be disposed of right now without referring the matter to a committee and waiting for them to get hold of the members, ascertaining public sentiment and report it. Understand, the Chair is perfectly willing to appoint a committee and have it report, if it is your pleasure; but if there is any general sentiment in favor of the suggested place, I think we may act on that now without the appointment of a committee.

On motion of Mr. J. B. Howard (seconded by several) after the vote was taken the President announced that Chicago had been unanimously selected as the next meeting place.

The President having called Mr. O. O. Thwing to the Chair read the following

INAUGURAL ADDRESS.

The preponderance of custom in presidential addresses is to describe in general terms the prosperity of our business, praise ourselves in several fashions, throw out a lot of maxims as to increasing the use of gas, plead for the increase of gas engines, advise the members to work diligently, and otherwise consume about 20 pages in platitudes, reviewing and generalities that usually are well understood and accepted already.

I propose to vary this by skipping the usual felicitations, dwelling on but few technical matters and by discussing and even criticising some association matters. Criticism usually provokes discussion and discussion usually leads to some improvements, and that is what I hope for. If you ask by what right I set up to preach a little, I say that the very office of president carries with it the obligation to give more than usual thought to internal matters and a duty to point out where improvement seems possible.

Obituaries.—The point I shall make first, because of thus the more honoring our past members, is the belief that the average association does not in its yearly gatherings show sufficient respect and appreciation to the memory of those who may have died during the year. The President in his address usually says "Death has again thinned our rank," A. B. C. (as the case may be) having died during the year. Now and then some remarks are made. In some cases a committee is named to send resolutions to the family. Often but three or four minutes only of our

time actually devoted to the memories of the dead. I think this short time is a shame. We come here year after year, shake hands with a good fellowship, give mutually of our knowledge upon a timely controversy, chat in the corridors and with the amusements, the next year the chair is empty: poor Bill Smith is gone—who is the next superintendent? "The King is dead, long live the King!" Only a half dozen intimates seriously realize the real man; he not know it, but few realize the work and the good that remain from the life of the one who has gone. I think not enough. If I work for this Association, write papers or [illegible] and whether wisely or unwisely, [illegible] advance its interests, when I go, I want more than two lines in the presidential address, or a committee hurried reading at noontime so as not to miss the excursion. Seriously speaking, I think we might to make more of a feature of bringing out in the first morning session who and what the men were who, in the preceding year have answered a greater call call than that of any earthly association, and whose face and hand strike are gone forever. I recommend that it be made the fixed duty of the Secretary, upon the occasion of every death, to assign to some member well knowing the deceased, the melancholy duty of preparing a biographical sketch of his professional career and Association work; that this be formally read; that during this period of our session, running in and out of the hall be absolutely stopped, by sergeants at arms or otherwise, at the doors, and that a resolution of sympathy and copy of the proceedings of this Association always be sent by the Secretary to the family. These things are very grateful to those at home. Whether high in our ranks or humble, at home the one who has gone usually was their all, and his recognition on some such lines by his business associates is something dear to the wife and children and one that is long treasured. In the very few instances where such action should be either omitted or amplified, our directors can act. Let us cross bridges when we get to them, and hereafter those members listening to these words to-day, and who may pass away before May, 1905, may be more greatly revered than in the past. Can we not inaugurate a practice of greater evidenced respect?

Association Work.—The chief purpose of an association is that of gaining and exchanging knowledge and especially on so-called

"practical" lines. Many ingenious schemes have been devised to that end by various associations, such as an advertising department, new business department, question box, progress department, etc., most of them following the general lead of the Wrinkle Department, first started by this Association. But in addition to procuring knowledge, members often want to procure *people and machinery*, and I have to propose the creation of a simple plan to that end, that to me seems entirely practical, as an aid to one's getting, when wanted, brains, brawn or pig iron, as well as the technical data we now get. That is, let the Secretary maintain a record of all duly reported apparatus or machinery that any member may have for sale, outgrown, etc. Any member wanting to know what is available for sale or exchange can write the Secretary and get a copy of what is listed. A fee of say 50 cents or some suitable sum should be paid for postage, typewriting, stationery and Secretary's work that is extra. Would this not quickly develop into a clearing house of information as to pipe, meters, pumps, boilers, exhausters, and portable gas works apparatus and machinery that could be picked up cheap, by and to the advantage of the small companies especially. The correspondence and trades would, of course, be carried on direct, so that the Association would fill only an introductory capacity, and have no responsibility whatever beyond that. A clearing house for people, superintendents, office men, foremen, etc., could be handled on precisely the same lines. A man dissatisfied or anxious to advance could file his qualifications and facts. An inquirer would have forwarded him by the Secretary memorandum of all on file in any class designated, and then they would correspond direct.

I predict that if tried, the plan would work well and also be copied by other associations.

Gas Association Consolidation.—And now gentlemen, let us wrestle with a larger subject; that of the growing question of too many associations—a subject that nearly everyone concedes, as far as I can observe, informally, and yet that no one seems willing to come out upon officially. As I have no individual association ambitions, am relinquishing my unsought present office to return to the ranks, have neither axes to grind, trade interest to protect, but quite the contrary, I imagine I can make

the following remarks with the least amount of the usual resulting criticism for having "spoken out in meeting."

There are too many associations in this country. Or rather, each association in itself is legitimate, earnest in its work and theoretically all right, but practically there is too much waste of energy and of money *spent in parallel*, competition for membership and sometimes resultant and unnecessary jealousies. For instance, take the Ohio Association. It is avowedly aiming to become a third great national association, for which I can locate no demand whatever. Organized, looked upon, accepted and praised for years as a strong State Association, to improve and protect the interests of Ohio gas companies, it is raising heaven and earth, and the quantity of mail bags required in the postal service, to get a national position, by soliciting memberships from Portland, Me., to Portland, Ore., and all the towns between. It is arousing much criticism in so doing, and for what purpose? An ordinary gas man, say in Wisconsin or Virginia, can go to but a couple of meetings a year, and is not going to the Ohio in addition to his own State meeting and to the big association meetings, which have the first choice. And is a large numerical paper membership desirable to people who do not come to the meetings of the association? With the big campaigning of this spring and 188 new memberships secured by the Ohio, there was but a small percentage of either new or old members present; many of the new were already members of other associations, and only doubled up on dues, and with a total for the meeting of 430 or so on the rolls, they could not get more than 68 railway certificates. I tell you, gentlemen, it is a tremendous lot of misspent energy. Do not misconstrue my position. I have not an atom of antagonism to the Ohio, excepting this recent policy, and what I am saying and describing is to lead up to not what the Ohio happens to be doing; but what all our associations, in my judgment *ought* to do. I am a member of the Ohio; have written papers for it, esteem it, have worked for it and will work for it. I like and admire personally those who are shaping its policy and work; the recent voluminous Ohio "Question Box" is in the main great. But why should not all this magnificent energy to create a new large association be expended through, and in conjunction with, existing other associations, instead of separately. If it is because of jealousies

or pride, or local reasons, such is precisely my point: *It is about time to get together.*

The principle of consolidation is so universally recognized, that any special comment in its behalf is almost unnecessary. We recognize its desirability by consolidating in our own business in every way; departments are consolidated to decrease the expense and improve results; plants are consolidated into single stations; companies are consolidated for the same purpose. The tendency is marked and recognized in almost all lines of business and the results are almost invariably beneficial, both directly and indirectly.

At the present time there are nine associations of gas men in this country, with about 2,600 individual, separate memberships. These nine associations involve nine separate annual meetings, nine sets of officers and other necessary expense, nine editions of proceedings, with their expense of publication, nine secretaries, salaries, etc., etc. In addition to this expense of money, there is a great expense of energy and time and labor from the fact of each association often threshing out the same thing on its own account that is at the same time being done—or has already been done—by some other association, and by various members writing upon the same subject, and often writing virtually the same thing. The various associations also interfere with one another to some extent by the fact of the yearly meeting necessarily coming at the same time in several cases. For instance, it is impossible for anyone desirous of attending the New England meeting to likewise attend some meetings in the West, all of which occur in February, and it is practically impossible for anyone to attend all of the meetings in any event, owing to their numbers and scattered locations. Our supply men members especially feel this. A very important question further is the fact that different standards are proposed and adopted by the various associations, making complications in our technical work.

It seems to me self-evident that more or less of a consolidation or uniting of our associations would be to our benefit. It should be possible. The men who direct and constitute them are practical, experienced, broad minded, and as a rule thoroughly desirous of advancing the interest of the gas business, aside from personal ambitions or prejudices. Nor ought it in theory to be

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... has yet been possible.

Local State "chapters," wholly for State purposes, could be maintained by those so desirous at an expense of but a dollar or two a year per member, without complication to the general organization. The result of this combination would be uniform standards, for instance, proposed, recommended and adopted on behalf of gas interests at large, from the Atlantic to the Pacific. It would mean a gas organization, national in reality and far more powerful than ever before, or any now existing, with a solid and united front, that would be of great value in matters of legislation, franchises taxation and representation of the industry from time to time as occasion arose. Such a united organization of the gas interests of America would then be abreast of such organizations in many other engineering lines, a position lacking heretofore, that would advance our standing in the eyes of all observers.

I recognize that some years ago a plan of federation was proposed, not at that time favorably considered. That plan, however, was much short in my opinion of what it should be. It was merely a federation of the associations by each association as a whole, not as individuals. Each association counted but one vote, and a small State organization of 50 or 60 members, therefore, had as much influence as the largest, which was illogical. Its operation virtually contemplated only the publication of proceedings on joint account (which aroused the gas journals), and of several committees upon investigation, standards, etc., on joint account. It did not contemplate the union of the aggregate members of the various associations into a common organization man for man, and as individuals, with the financial revenues that should result, and many of the benefits that I have above referred to, and that I believe are possible.

The subject is a weighty one that, of course, cannot be acted upon either favorably or otherwise without most careful consideration and investigation of ways and means and probable results. But with all of the theoretical arguments in its favor, and many practical points of benefit that are obvious and admitted, and comparatively little to be said in the negative, it does seem to me that the time has come for an earnest effort to be made for the union, not of any particular two associations but of the majority of all of our associations, into the solid organization proposed, more powerful and more capable than ever in the work of

advancing the interests of the American gas industry, and an organization that should add to the prestige and successful record of development enjoyed by the gas profession of this country.

I believe that this Association would be found ready to appoint a committee at any time, prepared to confer with committees that I hope will be appointed by other associations, to act on this subject.

Mark my words, gentlemen, we will consolidate in some shape before we get through, not because we are not doing very well now, but because consolidated we will do very much better.

Gas Congress.—I commend to your interest the Congress of our United States Associations that will convene in this city tomorrow. And I take some pleasure in pointing out that it is the direct result of a communication that, as your president, and acting for this Association, I made to the council of the American Association in October last in Detroit proposing that the American and Western, the two major Associations of the country, unite to hold such a Congress, inviting the other associations to participate. While the American finally elected to do it but in his own name, your Association has, nevertheless, aimed to do everything possible to enhance the success of such. It has advertised it twice extensively, twice issued announcements on its own Association meeting invitations, to remind gas men; has condensed its own meeting into one day; has advanced its regular date of meeting a month to insure the Congress a good attendance; has assisted financially and in the local arrangements; and is contributing three of the five or more papers that will be read at the Congress.

I am sure you join me in the earnest hope that this first common gathering of the United States associations may be a great success, that it may lead to a greater appreciation of other associations, each by the other, and be perhaps a first step in a future union on some lines of all.

Ceasing now my "house cleaning" let us dwell briefly on one or two technical points.

Improvements.—That which impresses me most is how the gas business keeps forging ahead, how volumes of output roll up, how the inventive chap keeps busy. Works after works report 15, 20 and 30 per cent. annual gain and larger works, too. Where does

it all come from? Advertising, education, good service, liberal policy, low prices, convenience of gas; each of these are some of the answers. And as to equipment: Old-fashioned horizontals are followed by inclines, and before they are cold come rotary, whirligig coal projectors of exceeding attractiveness, and even while they are abornin' vertical retorts are being tried again in several countries with high promise of success, perhaps in the near future to do away with machinery entirely. Verily, the last chapter is rarely written.

Mechanical Handling.—Concerning our works there are but two questions I wish to dwell on. The first is a greater use of mechanical conveyors or machinery to save coal and coke handling in the average works, and I mean small works.

For instance, a plant running 4 to 6 benches of 6's can put in a conveyor to take coal from the spouts of a coal bin 100 feet long at the ground level, lift it up 25 feet, crush it to uniform size and carry it over to the retort house, say, 100 feet, discharging it into convenient small bins in the roof for about $4,000. Such a plant will run over in an hour enough coal for all day into bins, whence it can be drawn as needed by spouts in front of each row of retorts. The interest on this investment at 5 per cent. is $200. Will not $200 of labor a year be saved by such a rig—and even if not, is not the convenience, the capacity for the future and the improvement of men's condition worth that much? On coke (and for oxide also) a light, simple rig comprising dumping buckets, carried on overhead rails of 6-inch I-beams leaning out to the coke sheds, is immeasurably superior to the usual barrows or wagons on rough floors or rails, costs but little, is well worth while, and can be amplified to any degree desired according to the size of the works.

In the last 2 years a good deal of study of this handling of coal and coke has convinced me that many works, and the average works are under-equipped, are working crudely and laboriously compared with what might be, and could save money and greatly improve their convenience, economy and quickness of working by adding small conveying rigs. On the other side of the ocean where they have been in business longer than we have they have better learned this lesson and have many more mechanical rigs.

Pleasing Architecture.—My other point is a plea for better architecture in gas plants. There are too many buildings which

are put up by mere country masons or constructors (unguided by the superintendent) who have not the remotest idea or object beyond a tight roof and sound walls. As a result the race of plain, homely, white mortar, plastered, usually corbelled brick is perpetuated, and the gas factories generally are as homely as ever. A little intelligent supervision would greatly improve this. Red mortar instead of white, dignified lines, some curves between pilasters, instead of square panels, an ornamental key over the window and door arches, doors and windows located symmetrically, instead of hit or miss; such things scarcely add to the cost and make a vastly better looking result. I recognize that in piecing out an old works, conditions often do not permit or warrant this. Yet in new detached buildings, and certainly in new plants (and there are a score a year constructed), more attention should be paid to *looks*. It improves the labor tone, you can brag of it to your neighbors, and get 5 or 10 per cent. better prices on *looks* when you combine or sell out to a syndicate.

Progress.—In closing, let me add only these words: The gas business that was to be put out of business by the electric people, that was also declared made extinct by the acetylene chaps, and that has been threatened also by various other "would be's," is yet a mighty lively proposition, and a pretty good business to pin to. It has solved many troubles arising in its own operation, it has gone through troubles arising from outside, it has given vast comfort and convenience to the public outside. It has its problems yet to solve. The chap who perfects the gas heater for cellar furnace work, who perfects vertical retorts, who invents a gas turbine engine, who evolves such an equitable labor scheme as will solve the strike question, who gets us upon a uniform and fair franchise and tax basis, who gets gas from the air by successful nitrogen elimination process at a fraction of our present costs, each of these chaps can smoke perfectos and leave fame and dollars to posterity.

And as we saw wood while solving these problems, each with the best intelligence that has been given us, remember that the old war-horses in the business have learned three maxims of success, I find, and which I commend to those coming into the business: "Venture to try new things; work; play fair."

On motion, the address was ordered referred to a committee of

three for consideration. Chairman Thwing named as such committee Messrs. Paul Doty, H. L Doherty and Rollin Norris.

AN ANNOUNCEMENT FROM THE COMMITTEE OF ARRANGEMENTS.

MR. COWDERY—Gentlemen, your Committee of Arrangements regret that they are unable to have located except in one hotel in this city, so as to make it most convenient for you, but you all probably understand how impossible it was to do that. Your Committee did the best under the circumstances that it was able to do. The Committee have provided an entertainment for the visiting members a little beyond the ordinary, because this was considered an occasion beyond the ordinary. Banquet tickets are sold at $5 each, as is the custom, but anyone purchasing a banquet ticket is entitled to the privileges of the balance of the entertainment. Tickets are furnished with the banquet tickets which will entitle you to the entertainment upon the "Pike" to-morrow evening. The members will have to pay their own admission to the grounds. The presenting of coupons encountered so many difficulties that the Committee were unable to carry out that portion. The members will assemble on the St. Louis Plaza, opposite the Louisiana Column, promptly at 8 o'clock tomorrow evening, to take the boats for the ride around the Lagoon, where they will have the pleasure of seeing the cascades in all their beauty, and the buildings illuminated. This trip takes something like half an hour. Upon finishing that trip, the members will proceed to the "Pike," and enter at the end here promptly at 9 o'clock. From there they will go to the North Pole promptly at 10 o'clock, and further, to the Paris Theater, at 11 o'clock. It is supposed that the entertainment will be through between half past 11 and 12 o'clock. The tickets only entitle the members to enter the various places at the hour named. Of course, those wishing to omit any one of these places would simply be on time at the next place. You will notice carefully that the tickets for the "Pike" entertainment are for gentlemen only, and the gentlemen will please furnish such other entertainment for their ladies during that evening as they can. Should a stray lady accompany a member upon the lagoon ride, if she has a ticket, there may be no particular objection; but you

will be called to dispose of the lady immediately afterwards. The members having number tickets or standing here will please register with the clerks in the committee room to the right, the name of the ladies accompanying them. Each member is entitled to tickets for the immediate members of his family attending with him, not exceeding two, and extra tickets can be bought for the ladies at $1 each. In registering these names, the tickets will be assigned a little later after we learn about how many ladies there are to partake of this entertainment. If the number does not exceed the number that the committee have made arrangements for all of the ladies registering will be provided with the tickets free of charge, but otherwise the committee will be obliged to carry out the programme under the rules as laid down. Every member of any association in the country attending this meeting is entitled to one of the souvenir badges and can obtain them from the clerks in the room to the right. Should any member desire more than one of these badges to carry to his daughters if he has more than one, he can obtain them by paying $1.50 for the extra one. These badges are a special design made for the gas men for this meeting by a jewelry house of this city and gotten out as nicely as this committee were able to do with the means at hand.

THE PRESIDENT—I take great pleasure in calling the Association to order to listen to a paper by our esteemed good friend from New York, Capt. William Henry White. Owing to absence abroad Capt. White was unable to have the paper printed in time for distribution, so I will therefore ask you to more particularly follow the reading.

CAPT. WHITE—I may say first that it rather dignifies a rambling Capt. White talk to be called a paper; therefore, it is a "talk." I believe the paper is scheduled as a paper upon "Low Candle Power Gas." As I begun in my last hurried moments to write it I finally found it was entitled,

SOME THOUGHTS ON CANDLE POWER,

and with your kind assistance and forbearance I will proceed.

Then Capt. White read as follows:

I may preface this paper by frankly admitting that it is not intended to be a scientific treatment of the subject presented,

nor will it contain carefully prepared analytical tables of the various gases produced in this country, pointing out their illuminating or calorific values, nor giving hair splitting comparisons of actual or suppositious cost of these gases. Rather will the paper give some of the impressions of the writer that have grown along with his observations and experiences in a long business lifetime, spent in the gas industry and in its various departments, extending from the coal shed to the president's desk. During this generation of experience many changes have come and gone, leaving little mark upon the industry, while a few have survived the test of use and time and are to-day standard practice with us. One lives to learn in the hard school of practical workings that change is not always the sure forerunner of improvement, and that nothing is either half so good or half so bad as its promise when first met. It has been falsely said that "a lie well stuck to is as good as the truth," yet we do live to see occasionally an error in judgment, a misconception of a scientific truth, become so fostered by circumstances and bolstered by an apparent great need as to become, for a time, the accepted practice of an industry or a community. We have seen in our industry a decided blunder in gas making theories taken as a great and valuable change in our methods and theories, and, thriving on our thoughtless acceptance of the claim, develop into an established practice that has cost both the gas manufacturer and the consumer vast sums of money, needlessly wasted, that were of questionable benefit to anyone concerned. Yet, at the time, this change was hailed as the greatest achievement of that day. We now see more or less clearly, according to our light on the subject, that this change became the rock of offense and a stumbling block to our feet in the pathway leading to the real, scientific and natural development of our industry, along the best, indeed, the only legitimate line of this development. I think that but few of this audience can hark back with me in memory to a personal participation in the work of the gas man at that interesting period in our history, when the clay retort, and its handmaid, the exhauster, had just won their place to a permanent place among the family of gas apparatus, when high heats were the drawing possibility with us, and the more daring among us were hitching their five-feet-to-the-pound wagon to the star of progress. Then came to us the first real awakening that set us to climbing

[illegible] progress that has led to the remarkable [illegible] of the gas plant of to-day and the develop[illegible] of gas engineering to its present high plane. [illegible] marked the beginning of the end, the passing as [illegible] the realm of pleasant memory of the genial, kindly, [illegible] gas maker who, but lightly burdened with scientific [illegible] chemical or mechanical information, fought his way [illegible] of an industry that had then to borrow from all the [illegible] professions and make precedent and history as a part of [illegible] work. These men who by dogged sticking to their [illegible] worries and problems and pioneer like, hewing their way through the unknown forests of gnarled and troublous questions, honestly giving to their consumers and owners alike the very best of their earnest usefulness, laid firmly and deeply the foundations upon which the successful gas engineer of to-day is erecting the structure of his prosperity. Grateful memory is due to him now, that he who then had no betters, as he passed off of the stage of active life and its labors.

The gas engineer has never had an easy time from the day that Wm. Murdock lit the first bilious-looking, evil-smelling coal gas [illegible] in far away Scotland, down to the trained engineer of [illegible] who, controlling the best of appliances and unstinted [illegible], still stands unsatisfied and questioning, contemplating the [illegible] far-reaching problem of his business life.

Now, what is that problem when reduced to its essence? Is it [illegible] we have, after vain wanderings, gotten back to the orig[illegible] purpose, the one real reason for the continuing existence of [illegible] as a business that flourishes in spite of all competi[illegible] That is the demand of the public for a cheap, cleanly gas [illegible] value applicable to all, and sundry, the varied [illegible] lighting and power uses. A gas equally useful [illegible] of flat flame burners, in heaters and ranges, and [illegible] a wider use of the gas engine with its marked [illegible] a wide field of usefulness, for which its clean[illegible] so amply fit it. The great need of [illegible] rather by its excellence as a heat pro[illegible] on an official photometer as an [illegible] We all know that to-day, in any well handled gas [illegible] of the output is consumed for [illegible] purposes in which its illumi-

nating value is of no benefit and its heat value becomes of supreme importance.

This being the problem before the industry, perhaps, harking back for a moment, the "old timer" who was content with an output of 16-candle power gas in the large cities and 14-candle power in the smaller ones, was not so far wrong after all, nor so fast asleep at his post as we youngsters who came along to disturb his peaceful and complacent hours with our talk of new-fangled processes and improved machinery then thought him to be. He evidently was sitting at the doorway of great riches, but seemingly was not aware of it then. It is a vast field for speculation as to the might have been, should we undertake to consider the immense saving of money and energy had those pioneers of the business been enabled to improve machinery, methods and output so that the solving of this problem of a proper gas supply had been retained in their hands, instead of being handed down to the men of to-day. Apparently neither the gas man nor the consumer was ready then, nor was the time ripe for the full fruiting of the tree of opportunity. Marvelous and devious are the ways along which great worldly changes and human benefits come about. So all through—30 years ago we were standing at the threshold of what is yet to be the great final evolution of the gas industry; we stood as men devoid of sight, hearing and understanding. Both the gas maker and the consumer had to be prepared by a period of educational development so that the scales might fall from our eyes, our ears be opened and the light of understanding illuminate our road to the better ideals. Then it was that the voice of the promoter and his satellite, the process inventor, was heard throughout the land. And we blindly began yet another search for the mythical golden fleece with all the incidental wanderings into strange promised lands, its moving adventures, its costly experiments and the nourishment of ill feeling among the fellows of our craft. But now the rising sun of the newer, truer thought sees the battered barks of the weary wanderer, hurrying back into port, seeking rest in the old, safe home harbors of the settled axioms of the fathers of the industry.

And the promoter; what of him? Well, the city fathers and the dear public they represented believed the glittering tales he told and saw old Fortunatus pouring out his treasures on their respective communities, until no city was really modern and up-

to-date that did not harbor at least one opposition gas company. Here let us stand for a moment at the cradle side of that enfant terrible that degenerate scion of the gas industry. High candle power gas—sired by the greed of the promoter, "dammed" by petroleum out of old mother earth—this fateful child has cost our industry millions of dollars and checked its true development for a quarter of a century. The wicked fairies surely attended that birth and left behind a very Pandora-box of evils for us all.

Once the public mind grasped the fallacious theory of the promoter, that it was being cheated at every turn, it wakened to its great power for harm and began to demand far higher candle power than could be utilized, and placed embarrassing restrictions upon all semi-public utilities, until to-day we face almost socialistic conditions in dealing with cities, and find it daily growing more difficult to meet the proper claims for a good and cheap gas and to balance the ledger on the proper side of the profit and loss account. What an aftermath is this we are reaping from the once fairly fruitful field of our industry, and are now storing in the barn loft of hard-won experience from this careless sowing of the whirlwind of patent process gas of any old candle power. Many who found profit then are willingly seeking safe cover now. For a moment let us consider what the dear public got in all these years of riot. Well, it got better service along most lines, a gas that figured well in photometer records, and looked well in the flame of the especially adapted, high priced burners in the gas office, but did not develop much better light in their old-fashioned corroded burners at home. The then new lava-tipped burner, with which the new gas man came to their aid, promptly put a fine frieze of smoke on the side walls and frescoed the ceilings of the homes of the consumers in dark neutral tints. Really, nothing substantial reached the public, save a brief-lived reduction in the size of the gas bills, while the competing companies were reaching the inevitable conclusion of hostilities by purchase of the intruder or a division of the territory served. After that the consumers paid the interest on both capitals and got what was left—got it, too, where the dear public usually gets it!

The practical object of this paper is to assert that the excessive enrichment of illuminating gas in America, which has marked our practice for years past, has been so much wasted money taken

from the pockets of stockholder and consumer alike. For while the former has been paying his money to produce and maintain an unnecessarily high standard of gas illumination, which the latter has not been able to fully avail himself of, but paid for his share of the burden of its manufacture in the high gas rate involved in the transaction. In educating our consumer to exact a high candle power gas, we have for long years been working at the wrong end of the problem of lighting supply.

Really we have been maintaining a sort of "Circumlocution Office" and have succeeded in training ourselves to know "How not to do it." For all these years the dumb, unspeaking burner has been our enemy; sitting in our camp and directly under our daily observation it has steadily nullified our best efforts to give the consumer that "twenty-two," or better, candle power gas that he was paying for but seldom getting. Here was the neglected point of attack for our inventive abilities, upon which so much then and now depended. We well know that gas of a given candle power can range through a wide gamut of illuminating value, dependent largely upon the character of the burner in which it is consumed. That this is the statement of the fact a glance at any one of the many tables of gas and gas burner tests will verify. The burner best adapted to the character and quality of the gas to be consumed will alone develop the best illuminating or heating values of the gas tested. Your 20-candle gas can be anything, in its efficiency, between the range of say, 80 or 90-candle power on the incandescent burner to 7 or 8-candle power on the small and poorly adapted flat flame burner—with the average burner in the average household in our cities, 10 or 12-candle power must be a fairly general average of the lighting results had. This being true, why do we continue to tax the income of our companies that we may send out to the consumer a quality of gas that he does not secure the benefit of. Our contracts call for it and the consumer pays the bill.

Part of the work yet before us is to re-educate our public to know the truth, and the truth shall yet free them from the effect of our great blunder. It may be said that as yet in this country there is no loud call for the new gas method. Well, perhaps not from that lessening percentage of our consumers who still use flat flame burners, and gas only as an illuminant. But are we not daily in touch with our real consumers who, for fuel and power

purposes, urge on us that a cheaper gas of good heat value is their great need, and do we not know, past all doubting, that if we could only send out a good, well made gas, having a heating power of say 550 to 600 heat units, that could be sold cheaply and still earn dividends for our owners, that our business would develop more rapidly than our gas works could be increased in manufacturing capacity? Saved from the increasing dangers of the incandescent electric lamps by the timely discovery of the incandescent mantle with which Dr. Auer Von Welsbach came timely to the rescue of our industry, have we not learned, through that piece of almost miraculous good fortune, that to-day our industry stands upon an entirely different plane from that occupied by it 20 years ago? A plane which the greater part of work is to be done for consumers having not the slightest interest in the initial illuminating power of the gas, other than in so far as it may be a factor in assisting in the production of heating power. Every year in well handled gas companies the number of consumers who depend entirely on the flat flame burners grows smaller, while the incandescent burner users grow steadily in numbers. Probably to-day 75 per cent. of the gas business is free from the trammels of the question of illuminating power. Is it not time for us to get to thinking and to applying our thoughts? As Rameses of old said of the Egypt of his day: "I set the boundaries of my country where I choose." Is it not equally true in our case that, by the zeal and energy with which we attack this question of heating gas at popular prices, we too may be able to set the boundary of our gas domain where we please. It is a business truth that you have only to find something that the people need; let them know that you have it, then sell it cheap enough and your fortune is assured. Now, more than ever, we need that triumvirate of good things in our business—good cheap gas, good cheap burners, good, well paid, brainy gas men. Germany shows what can be done in one direction, for practically 90 per cent. of its gas output for illumination is used on Welsbach burners. Of course, we have some disadvantages over here as to high prices of burners and mantles, but we can and must get there.

I have purposely refrained from setting up my standard of illumination for the lower priced gas that is yet to come into use, enabling us to enter upon and control this vast, unoccupied field

now lying just outside of our own special farm, as I readily forsee that the steps downward and backward, the troublesome undoing of our well-meant work of the past, will call for tact and diplomacy, concessions, and an educational campaign that will test our best selves. So we will work that out at first; each for himself. But whether we land at 16 or 18-candle power or drop back to lower levels, will depend on what we develop while keeping the standard of calorific values, which we may adopt, before our eyes. For we may as well begin to custom ourselves to missing the bar photometer from its high place as the fetish of our business; for it must join grandmother's spinning wheel in the old garret, the limbo of outused things.

The pyrometer and the calorimeter for us in these days. These shall be our guide and compass in the new days, while a watchful eye will be kept on the simple chemical test apparatus that will note for us the presence or absence of our necessary friends, marsh gas and its bevy of sister hydrocarbons of riper and richer usefulness to the gas man. For on this family much dependence must be had. Then it will not so much matter what the name of the process may be or what marks the photometer would give your gas, so long as the finger of the calorimeter points steadily to the chosen mark of B. T. U.

I feel that we are now sufficiently well equipped in plants and trained engineers to commence this work of development, and wish now, lest I may have been misunderstood, to say that I fully appreciate the value to the industry of the splendid apparatus of the modern carburetted water gas plant.

This gas has come to stay, and the apparatus is a tried and approved part of the accepted machinery of the gas works, having long since proved itself a valuable addition in many ways to the coal gas works and a most valuable standby in times of need and trouble. The part it is to play in the future is as well assured as is its present status. I do believe, however, that, owing to its many advantages, coal gas must stand as the backbone of the cheap heating gas suggested, for from it must be obtained the necessary supply of hydrocarbons to produce the heating value of the gas, and the coke for use in the water gas adjunct.

The development of proper burners, both flat flame and incandescent, needed to secure the best lighting results and all the questions involved in the economies of this work, necessary

[illegible] changes in methods and apparatus at the gas works to secure any possible increase in the volumes of make per unit of apparatus, and the economy of the use of the gas at the burner. I can safely leave it in the capable hands of the American gas engineer, who, with the other mechanical engineer and the gas chemist must solve all these questions. This is an age of machinery, and I am inclined to believe that through it all much may yet be accomplished in lowering the cost of our output of gas.

Before we lose the promised land flowing with the milk and honey of opportunity to those who have the courage to cross the Jordan of their limits and occupy its fruitful valleys.

DISCUSSION

THE PRESIDENT.—Gentlemen you have heard a calm review of the underlying principles of a question which is certainly a growing one. I hope those who desire to participate in the discussion will feel free to do so and do it fully. Bring out the facts whether we are going to make 22 or 14-candle gas in the future of heating value sufficient for cooking purposes and for incandescent burners for lighting, or whether we are going to expect the continuance of 18 and 20 or 25-candle powers as at present. Discussion is in order.

MR. FORSTALL.—I think that Captain White's rather passionate arraignment of the poor gas engineers who made the choice between low candle power coal gas and higher candle power enriched gas in favor of the latter, is not justified to say the least. Fortunately for gas companies, people who wish light have always wanted to get it the cheapest way they could. When the question of richer gas than could be produced by ordinary coal gas methods was brought before the gas men of this country, it was almost absolutely necessary for them to make a higher candle power gas in order to retain their business. Gas could only be burned economically in flat flame burners. There was no other burner that could be given to the consumer that he would use. None would use the Argand all over their houses although it might be used in special places. The electric light had just been brought into use, and its promoters were boasting that they were going to drive the gas companies out of business inside of 3 or 4 years. The way in which that competition could be most successfully met was by

higher candle power gas, which could be made, candle power for candle power, more cheaply than the comparatively low candle power coal gas. It was no mistake of judgment for the gas engineers of that day to take the action which they did under the conditions that then existed. The conditions that existed then exist no longer, but they did exist as late as 1892. My connection with the gas business does not go back quite as far as Capt. White's, but I remember testing one of the first Welsbach burners that was made in this country, and it was not worth 2 cents. We were making at that time 20-candle mixed coal and water gas, and we could not get from that incandescent burner more than about 5½ candles per foot, while we could get in our ordinary flat flame burner 4 candles per foot. The conditions may now be such that enrichment does not pay. When enrichment was adopted in this country they were such that it was absolutely necessary it should be adopted. Another thing I noticed in Capt. White's paper was that he charged the gas company (I presume the gas company of to-day) with allowing its customers to use flat flame burners that only gave from 10 to 11-candle power per cubic foot I presume, from gas that on the photometer showed 20 to 22-candle power. I think such companies have all gone into bankruptcy. There is no up-to-date gas company that does not see that its consumers get a burner that will give 20 or 22-candle power from 20 to 22-candle power gas. It is just as easy for the consumer to get the candle power as it is to get it on the photometer. Not being a candidate for a Presidential nomination, I think I am perfectly safe in saying that the candle power of gas is usually local; that it is a question that has to be decided entirely by local conditions. We are not selling gas for light only, in fact we are not selling gas at all; but, as Mr. Glasgow said in his paper before the American Gas Light Association last October, we are selling what gas will give, we are selling energy. You can take it in the way of light, you can take it in the way of heat. What the gas company has to do as to working out what will be the greatest success is what kind of gas, what quality of gas it can use and furnish the greatest amount of energy at the least price. A 50 cent gas, as you, Mr. President have shown in one of your papers, with only 300 heat units, is not worth as much as dollar gas with 600 heat units. Each company has to settle for itself the question of what kind of gas it is going to make in order to give the consumer

the most for his money. It may be coal gas in one place, it may be carburetted water gas of 22 or 24-candle power in another place. There is no fixing a law that can be laid down.

THE PRESIDENT—We have with us as one of our visitors one of our honorary members, a gentleman whom it is always a pleasure to see and who has come many a mile to meet with us this year. His position in connection with gas and electric matters in his own State is such that I think he is peculiarly able to give us some opinion worth while as to the proposed coming gas that we shall distribute, and I think we would all be very glad to hear and welcome a few remarks from Mr. Forrest E. Barker, Chairman of the Board of Gas and Electric Light Commissioners of Massachusetts.

MR. F. E. BARKER—I doubt if I ought to interrupt the even tenor of this meeting by any attempt to discuss this topic. I am naturally very much impressed with it. The companies in our State have not been especially ambitious to obtain the very high candle powers to which reference has been made. The legal standard was formerly 15, but for some years has been 16 candles. There has been no move for several years to raise this figure. An average of 22 candles would be very exceptional in our State. I have some doubt, taking the country through, whether the gas generally would reach the Massachusetts standard, although it may be true that the quality supplied gives as general satisfaction in the communities where it is used as it does in our state. The suggestions in the paper are very interesting, but I think there is also a great deal of force in the suggestion of Mr. Forstall that it may be very largely a local issue. There is pretty certain to be a general conviction in the public mind that if gas is of 20-candle power the consumers are getting more for their money than if it is 16-candle power. It may be true, as Capt. White suggests, that many of them are not getting more, owing to the unfortunate conditions under which gas is so frequently burned. One can hardly consider this question without being impressed with the importance of increased efforts by the companies to assist their customers, as far as practicable, toward securing the very best results from the gas they use. I think there is a growing tendency in the best management today to do more work of this character in order that their customers may get more value out of the gas. With increased attention it may be that, even with

lower candle power gas than is now commonly supplied, customers may be able to realize more for their money.

MR. A. S. MILLER—There is no suggestion in the paper that the heating power of gas might vary with the lighting power. Taking gas of 20 to 22 candles, the reduction of 1 candle reduces ordinarily the heating power about 3 per cent. If we are selling the gas at so much per unit, would not it be cheaper to keep those units in than to drop them out and make a corresponding reduction in the selling price? How many of our people could afford to reduce the selling price 9 per cent. in order to reduce the illuminating power of the gas by 3 candles? I think we could afford to raise the illuminating power 3 candles in order to increase our selling price 9 per cent. and give the consumer exactly the same amount for the money.

MR. I. C. COPLEY—The idea has occurred to me for some years past, in discussing this question of candle power and heat units, that every man who sells an article, who is in business permanently as we necessarily must be, must consult the needs of his customers, and to that extent, as Mr. Forstall has already suggested, it is a local question, to sell what is best for the customer in each locality, and that the gas man who does not know what is best for his customers certainly has not sufficient grasp of his business. It would seem now that the question must resolve itself into a fair profit for the company, and selling the consumer that which can be made to give him the best service.

THE PRESIDENT—It would seem to the chair that the point of the Captain's paper is this, if I understand it rightly: A superintendent is assumed as competent in the management and is assumed as competent to know what the public requires, and we pretty much agree what the public wants is heat; usually that is the preponderance. We are selling gas nowadays for use for heating purposes—50, 60, 70, sometimes 80 per cent. of our total output. I do not think it is looked upon that practically a reduction of price is necessary because of a question of reduction in the lighting value, but the practical question is this: If legislation, ordinances and stipulations permit it, could not we save some of the cost of manufacture and give the public the benefit of that in some other direction with the aid of gas that would be less smoky where it is used in flat flame burners, less liable in many respects to stoppages, having a less amount of carbon which deposits in various shapes. Could

not we substitute 14-candle gas and do just as well practically with but few flat flame burners, and putting out for fuel 60 or 80 per cent., as we are doing today in putting out an 18 or 20-candle power gas, if ordinance stipulations permit it? I understand that on the other side the commercial business is done on a much lower scale of candle power than is in vogue here; 15, 14, 13-candle powers in a great many places and in several countries. I expect those people want light just as we do, they want heat just as we want it, yet they are doing business year in and year out just as we are doing and propose to do. They have not been educated up to the 20, 25 and 30 candle power standpoint as was the case in this country as the result of a great quantity of cheap petroleum for many years in the past. We have been educated up by the ease of making rich candle power gas to high candle powers and legislation has nailed us to that position, and now when we find, as I understand it, that our commercial requirements would be satisfied by a good flame of clean, medium candle power and high heating value of gas (which 12 to 14-candle power gas would give), we find legal difficulty in taking up that commercial product on account of the ordinances that have been put into effect in many places in the last 20 or 30 years, caused by cheap petroleum in my opinion. If the people on the other side of the earth can do business among millions of population with 12, 14 and 15-candle power gas, and do more business than we are doing here, I do not see why it is not our destiny to gradually work to the same condition?

MR. PATTON—I have had to do with this matter from a power standpoint. My experience is we get a higher power efficiency with a low heat unit. We obtain as low as 9,500 heat units to a horse power. With acetylene gas the best result I obtained was 16,000 units, and you all know the candle power claimed for that gas.

MR. R. M. SEARLE—This begins at the point where you have to educate the public. We are all speaking of a gas of certain heat units, and give it the term candle power. That is wrong to start with. You go after a franchise; the first thing a lawyer asks is, "What is your candle power?" You answer, "We have 500 heat units." He sends to Chicago and gets a copy of a franchise that calls for 22-candle power. He again asks, "What is your

candle power?" "We have 500 heat units." "I don't care; what is your candle power?" It is 11-candle power." "Then Chicago is making twice as good gas as you do." You have to drop the term candle power and get some new term to educate the city fathers along the line of B.T.U's.

MR. W. E. STEINWEDELL—Regarding the electrical end of the business most of us operate electric light plants in conjunction with our gas business, and a parallel may be drawn from the arc lamp. In contracting for city lighting, arc lamps are generally specified, as the so-called nominal 2,000-candle power lamp or something to that effect, but the lamp only produces candle power according to the energy put into it. We all know that 2,000-candle power is only produced for a very small angle, and that it is not the average candle power by any means. The candle power of gas may be likened to the voltage of an electric current, and the number of heat units in gas may be likened to the amperes in electricity; both should be stated to give an intelligent idea of the gas or electric current.

MR. FORSTALL—Your remarks emphasize my position that in the question of candle power the question of quantity comes to be met as a local condition. In the countries of which you speak, which are sending out 12 to 14-candle power gas, they are doing it because they cannot make higher candle power gas cheaply. In this country we can, and there is no reason in the world why it may not pay us to make high candle power gas, even though it does not pay Germany or England to do it. Now, as to the question of being tied up by ordinances, the first problem that has to be solved is whether it is worth while to take the trouble to educate the public down to a lower candle power. If there is no object in low candle power, what is the sense of educating your public to it? You have got to settle whether low candle power is cheaper for what you ought to give the public than high candle power before it is worth while to discuss the question whether the public ought to be educated to low candle power. In a great many sections of this country low candle power is no cheaper for what you want to sell the public. In some sections of the country it is cheaper. It is entirely a question of how you can give the consumer what he wants at the least possible price. As to reducing the quality of the gas as to heat units or candle power, and giving the consumer the benefit some other way than

price, I don't think that will work. Even in the incandescent burner, in spite of what some of our English friends say, the preponderance of evidence seems to be that the higher the calorific power of the gas the more light you get, if you take the trouble to adjust the burner to the gas, and any man who is not able to do that ought not to be in the gas business.

THE PRESIDENT—Captain White will now reply to the comments made on his paper.

CAPTAIN WHITE—As to friend Forstall's reference to the elegance in which I always clothe my remarks, they seem not as attractive to him as usual upon this occasion, for he overlooked a whole paragraph in which I suggested or explained that this was absolutely a local question which each man would have to settle for himself. I could only lay down general propositions with the hope that you would take them home like a dog takes his bone back to his kennel to gnaw at it at his leisure. Now Mr. Forstall makes another mistake on this subject of high candle power. I have done the same thing myself, in that I have given advice and counsel which were wrong, but I did it conscientiously. I do not believe it is necessary to cram down the throats of our consumers a 25-candle gas when a 16-candle gas will do everything they want and which costs a lot less money. I am very glad to hear our dear friend Mr. Miller. He comes here in 1904, gives you the old story that I commenced to give you back in 1876, when I proposed some of the earlier changes in apparatus now common in this country. It is really amusing to have a man always begin at the wrong end to see whether he can put in a new purchase which will save 50 per cent. in the cost of manufacture. That is usually the argument of the directorate when you first undertake to convince them that a change of apparatus would enable them to pay added dividends, make some decrease probably in the cost of gas to the consumer, and which certainly would enable them to make better gas. Some of you have been received with the reply, "O pshaw! What is the use? We are making money now." If you say anything about public dissatisfaction then "If they tear the gas works down, let them go." That is about the way of it. Mr. Copley has about the right idea when he says it is simply a question of finding out what your community want and then giving it to them. It is with some satisfaction I notice that some of you come to think as I do.

It shows after all we have been thinking along right lines. Several things I have said with which apparently you have not had much sympathy, and then after a while I find two or three other fellows thinking the same thing that I did. I take a personal satisfaction in that. Now this did not pretend to be a scientific paper. As I said in starting out, it is one of those common, everyday talks which Captain White sometimes gives you and whether you like them or not you never throw mud at me. I appreciate it.

THE PRESIDENT—It is very fitting that Captain White should receive the usual vote of thanks. And I will take it as the sense of the meeting that we instruct the Secretary to have the record duly show that it is always a pleasure to hear from him. No matter which side he takes, the Captain can take either with equal ability, or both sides with equal alacrity.

INTRODUCING TWO ENGINEERS FROM FOREIGN LANDS.

THE PRESIDENT—This meeting has been out of the ordinary in having numbers of friends come from long distances. We have under our roof to-day not only our friends and members from Boston Bay and the good old down-east country, even beyond that, but also from the Pacific coast. We also have a friend from an even greater distance than that. Mr. A. Naito, Engineer of the Tokyo (Japan) Gas Company to whom I want to introduce you.

MR. NAITO—I thank you, gentlemen. It affords me great pleasure to meet with the gas engineers of this country.

THE PRESIDENT—It is a great pleasure to have Mr. Naito with us. We hope he will be with us as much as his time will permit and have a good time while he is with us. We also have with us —whether present in the hall or not I do not know, but attending this convention—Mr. Thos. Redman, an Engineer from Bradford, England, who became sufficiently interested in the Western's meeting to not only make a long trip to be with us, but also to send several gas machinery models that are on exhibit at Section 33 A. Mr. Redman I think is around, and I hope when you meet him you will extend to him the glad hand of fellowship. We are glad to have him here.

On motion of Mr. Somerville, the Convention adjourned to reassemble at 2 o'clock P. M.

AFTERNOON SESSION.

The President called the meeting to order at 2:30 P. M. The first business in order was the

REPORT OF THE COMMITTEE ON LIBRARY

which the Secretary read as follows.

St Louis, Mo., June, 1904.

To the Members of the Gas Association:

The Library Committee would report herewith as to the matter of Association Library during the year.

Primarily the predominating thought is regret at there not being a greater use of the Library during the year, or a greater increase in its volumes by the securing or donating of books by members. A through circulating of about 250 volumes, directly pertaining to our business and a list of which is printed with the membership list sent every member there have been but [illegible] names loaned during the year to about 16 members. Also the new books contributed have been nil, excepting for Proceedings received from other Associations, and a volume of Engineering Digest donated by the Secretary. This betokens either a lack of interest in the Library and that our Association is not [illegible] for it which we are reluctant to credit, or else some fault in the running of it. If any member has any thoughts or criticisms on these points it is sincerely hoped that he will express them now as the Secretary and the Library Committee will welcome any sincere criticisms or suggestions that will improve things or increase the Library's usefulness. It is likely that it is overlooked in greater things and that greater publicity is what is needed, and we suggest the advisability of the Secretary being instructed to send every three months, for the next year, a circular, [illegible] of it, asking for books, inclosing the list of books, to see whether this will improve its position.

The Special Committee on Card Index to Gas Literature, appointed by the Association two years ago, would report that [illegible] of the Indexes was completed about a year ago, [illegible] distributed to subscribing members; a sample [illegible], and examination of it (by those unfamiliar [illegible] what a convenient key it is to the most

important current or recent articles on practically all gas subjects. A number who have used it have commended it in very high terms, and ordered more copies.

The Chairman of this Committee constantly uses it in his own gas works, month in and month out, to locate desired information. There are still some copies on hand for further subscribers and new members.

The preparation of the cards was done by the Chairman of the Committee, and it has been expected that reference cards for the year 1903 would be prepared and ready for distribution and addition to the index sets at this meeting, but the unusual work of the gas exhibit has quite precluded the index. It is hoped, however, to cover this at an early date.

Respectfully,

F. H. SHELTON,
WM. MCDONALD,
T. D. MILLER,
JAS. W. DUNBAR,
Committee.

THE PRESIDENT—Gentlemen, you have heard the report of the Library Committee. The chief point seems to be to make the Library more appreciated and more useful. Are there to be any suggestions or criticisms on the subject?

THE SECRETARY—In the absence of any suggestions, I move that the report of the Committee be received and the recommendations concurred in. The principal recommendation is that a bulletin be issued every 3 months giving a list of the books contained in the Library and the use that the members can make of it, and also calling for new contributions from those members who have the success of the Library at heart. (Adopted.)

The Secretary then read the following.

REPORT OF COMMITTEE ON PUBLICATION OF PROCEEDINGS.

ST. LOUIS, MO., June 14, 1904.

To the Members, Western Gas Association—Gentlemen:

Your Committee on Publication of Proceedings begs to report that the Fourth Volume of the Proceedings of this Association

has been published during the past year, embracing the meetings from 1899 to 1902, inclusive.

The Proceedings of this Association are now published in book form, from the years 1887 to 1892, inclusive. It is hoped that the Committee will be able to publish the Proceedings of the Association previous to the year 1887 in one volume, which will be the next one prepared.

O. O. THWING,
WM. MCDONALD,
Committee.

On motion the report was received and adopted.

OBITUARY REPORTS.

THE PRESIDENT—Gentlemen, our next business is a melancholy duty and that to which we must particularly this year give heed. During the past year we have had several deaths, two of which were men distinctly out of the ordinary: Gen. Andrew Hickenlooper, of Cincinnati, passed away recently, as did Mr. Henry B. Leach, of Taunton, Mass., an honorary member of the Association. I think it is fitting that something more than ordinary in the way of mention should be given, and I will ask Mr. Paul Doty, the Chairman of the Committee on Memorials, to pursue that matter on lines that have been discussed.

MR. DOTY—The Western Gas Association in formal assembly is again called upon to record its appreciation of those absent members who have answered the greater roll call, and to express their sincere sorrow at the loss in membership and to give their sympathy to the stricken families. As our President said, death has laid a heavy hand upon the membership list this year. The men who have passed away have been more than usually prominent in the roll of the Western: The list includes Asa S. Bushnell, ex-Governor of Ohio; Henry B. Leach, of Taunton, Mass.; Thomas Littlehales, of Syracuse, N. Y.; and General Andrew Hickenlooper, of Cincinnati, O. It seemed fitting to your President, in view of the distinguished services of the gentlemen, not only to the gas industry but to their respective States, that something more than a mere mention of their names should be incorporated in the proceeding, and your President, therefore, has assigned to various intimate friends of these gentlemen the

preparation of a memorial tribute, and as Chairman of your Committee I can do no more at the present moment than to invite your respectful attention to these memorial addresses. To Capt. William Henry White has been assigned the preparation of a memorial to Gen. Andrew Hickenlooper.

CAPTAIN WHITE—I do not entirely agree with the view of the President, stated in his address this morning, that the time of these meetings, which is always limited, should be taken up in memorial addresses, but in all periods of our lives there are moments when it seems as if it were our wish to put our hands upon the wheel of time to stop it for a moment, that we might call to memory scenes in the life of a dead friend, and that we might consider the value of that life as spent in active service and fraternal association. I thus feel more keenly as my own years pass on, for I have seen so many men with whom I started in business life pass to the silent tomb, only to know that all that might have been said or done by their associates at the time of their death was not done. Mere funeral ceremonies, the mere passing of a kindly word as his associates meet together at their next regular gathering, do not seem enough. A man who has spent long years of manly, earnest and honest life in our midst, responding to the touch of the hand of death upon his shoulders, has passed away from the living to join the innumerable army of the dead. That we merely bow in acquiescence to this summons does not seem enough. General Hickenlooper was a peculiar instance of the made-to-order gas man. Trained as a civil engineer, he knew nothing whatever about the manufacture of gas until his association with the Gas Company, as the Engineer of the City of Cincinnati, gave him, with his keen insight into everything of an engineering character, a somewhat passing knowledge of our business. But his great abilities as an engineer had been made known to his fellow citizens, and when the Gas Company, feeling that in the ageing of their President, and the increasing demands upon the manufacture, called for a skilled and trained management, and reached out in search of some men to fill the place of the good, old-time gas superintendent, they naturally turned to a man of the education and rare abilities of General Hickenlooper. The General had been among the first to answer to the call of his country for volunteers to defend her from the attacks of the enemy. Without any previous

had never heard a gun fire in his life,
were not many salutes along the Ohio
General raised a battery, that was soon to
among the officers of the army that even any
at West Point might feel proud. He
of the Army of the Tennessee, which gave
command of a large part of the artillery in that
returning to civil life he brought with him
the home coming soldiers of those days, a
Selected to fill several offices, it is my
friend and his fellow gas man, to say that
selected no position in which to place
that was not equal to his grasp of the
with credit to himself, in a more
his having filled it. The step was a
of engineering to another, and I can
from any of you that no other gas
mountains did so much for the
so much for its working out as a
works were always in order, and his
step in advance of any other man's
when the General, through the over-
years, when paying the penalty of his
was stricken down so that he could not
upon the operations of his Com-
men about him to take hold, and he
equal to any plant in the United
ght and Coke Company actually
from the office to the sick
man It is a pleasure to know
them very strenuous ones, when
that was a wealthy one, that the
more opposition proposi-
to the lot of any one city.
indicated the complete and
approached every ques-
the parties presenting the
all they had to offer had
al, and that his defense
even the money of the

opposition company could purchase an entrance into his city, until Cincinnati finally reached the conclusion that its lighting supply was far better controlled through the hands of a man of this caliber than it might possibly be by any new service that was offered. I say through all that strenuous life, through all the activities of such a mind, the General enjoyed in professional life the love and respect of that community. He had more warm personal friends in Cincinnati than often fall to the lot of any active man of business. You may go to the Board of Trade, the Stock Exchange, along the streets with the merchants, everywhere you will find men who have only good words to say of General Hickenlooper. It seems to me that this sort of record is the very best of memorials that a man can leave, that the people remember you, not so much for the great things you did, not so much for the controlling ability with which you handled the industries that might have been entrusted to your hands, but that they reached down deeper into your being and recognized the true manly character, the kindly, genial elements that go to make up the value of manhood. I venture to say that of all the great men who have adorned our profession during my lifetime, and have left kindly regret among its members, none has passed out from the profession of gas engineering and left behind such a host of friends among the consumers, and such perfect respect upon the part of the officials of the city which he supplied, as did General Hickenlooper. (Applause.)

MR. DOTY—The Committee on Memorials has requested Mr. John McIlhenny, a personal friend of the late Mr. Littlehales, to incorporate in the proceedings a memorial to Mr. Littlehales.

MR. MCILHENNY—Mr. Chairman and Members of the Western Gas Association: As our eloquent friend Capt. White says, it is well for us to pause, even in the hurry of business, to do honor to the men who have spent their lives in the gas business with honor to themselves and benefit to the interests they so well served. Those of us who were their contemporaries and now survive them have had our paths made much easier than they would have been, by reason of their example, skill and wisdom; and I would advise the many young men I see here to-day to follow in their footsteps. One of the men (one of the brightest stars) to whom I refer, whose demise we regret and whose

memory we honor to-day, was Mr. Thomas Littlehales, who died at Syracuse, N. Y., Sunday, April 10th, 1904.

Mr. Littlehales was a member of the American and Western Gas Associations, and one of the most active and punctual attendants at the meetings of our organizations, always contributing to them the best information he had, and he was well informed. All of us knew he was kindly by nature, courteous in his discussion of any question before the Associations and willing to share freely with others his experiences. He took the time and trouble to come from Hamilton, Can., to attend the meetings. Attending the meetings regularly, he soon made the acquaintance of most of the members, and all who knew him respected him.

I have often heard him speak of the great benefits that grew out of our associating together, comparing notes and imparting to one another such information as we might have and that might be new, and no one was more willing to do so than he. One of the best things one can say of a man, when he belongs to an association for the mutual improvement, is that he is willing to impart to others that which he has acquired by painstaking industry himself.

At one of our meetings, I met a gentleman of Hamilton, Can., where Mr. Littlehales lived many years. This gentleman, speaking of Mr. Littlehales, said the United States had acquired a prize in getting him and that Hamilton had suffered a loss. What could he say higher of the man than that? What your neighbors say of you is apt to be a pretty fair estimate of character and reputation.

He was a talented man, and with his children constituted, perhaps, one of the most talented families in Canada, as they were all gifted with unusual musical ability. They were in demand everywhere socially, and he was very proud and fond of his family.

It is a sad reflection that such a stalwart character and splendid specimen of physical manhood, when comparatively young, should be removed from among us. We cannot question these inscrutable acts of Providence. All we can do is to bow to His will and deplore our loss, which we sincerely do. We wish to convey to the bereaved family our sympathy and condolence, which I suppose will be done by our Secretary in due time.

Mr. Littlehales and I returned together from the meeting of

the American Gas Light Association which was held in Savannah some years ago. We were drawn together on our way home, and happened to have a mutual acquaintance in a town about half way between New York and Savannah, where we stopped off for a day. It was on that occasion that I first found what a genial, splendid man he was—kindly, agreeable and companionable, and I do not wonder that his friends in Hamilton said that the community suffered a loss when he left that city.

It is well that tributes should be paid to the memories of those who have so well illustrated our profession, and I am sorry that I have not the eloquence of some of our members, or I surely would say more in regard to Mr. Littlehales, whose memory deserves to be kept alive in our hearts.

A friend has furnished me with some facts about Mr. Littlehales' life that I did not know before. He was born near Shrewsbury, England, October 15th, 1843. At twenty, he entered the gas business, under the late Mr. E. S. Cathels, who was then Engineer of the Crystal Palace District Gas Company, London. Four years later, he was appointed manager of the West London Junction Gas Works, which position he held for three years, when he was called to Hamilton, Canada, as Engineer and Manager of the Hamilton Gas Light Company. Mr. Littlehales remained in this position for 22 years, until 1895, when he became General Manager of the Syracuse (N. Y.) Gas Company. After two years' service with the Syracuse Company, he went into business for himself, under the title of the Penman-Littlehales Chemical Company.

Mr. Littlehales was a lover of nature in form, color and sound; his hospital home was a center for musical and literary gatherings; a deep and thoughtful reader, and, withal, a good citizen and true friend.

MR. DOTY—The Committee on Memorials has requested Mr. C. H. Nettleton, of Derby, Conn., to prepare a tribute of respect to the memory of Mr. Henry B. Leach, of Taunton, Mass., an Honorary Member of this Association. Mr. Nettleton responded as follows:

I have been asked to say a few words in memory of one of our Honorary Members, and one who to many of us was an esteemed friend—Henry B. Leach.

Mr. Leach died July 25th, 1903, on the boat going to Nahant,

with some of the Guild of Gas Managers, for an afternoon's outing. While sitting on deck talking to his friends he was stricken with apoplexy, and was gone almost instantly. He had left home that morning in the best of spirits, and up to the moment of his death was well and strong—active physically and bright mentally.

At the time of his death he had been in the employ of the Taunton Gas Light Company nearly 34 years, and for the last 21 of those years he had been the Clerk, Agent and Treasurer of that Corporation. How well he had performed the duties of his office the long continued success and prosperity of that Company prove beyond question.

His was a genial nature; everyone was glad to meet "Harry" Leach, as many knew him and as he was pleased to hear himself called by his old friends. To receive the warm grasp of his hand, to hear his hearty greeting and his good whole-souled laugh was indeed a great pleasure. Those who met him day after day, with all the cares and annoyances that come to everyone in active business, and which cause most of us to say and do some things which we wish afterwards had been left unsaid and undone—these bear witness to the kindly spirit of the man. His successor in office writes to me that "We who were associated with him for many years have not the remembrance of an unjust deed or unkind word."

An editorial in a local paper said this: "Genial, kindly and hearty, he was a man who easily made and retained friends. A good citizen, always ready to promote anything which tended to the betterment of public and social conditions, he used his influence and his powers wisely and well. A kind husband and father, his home life was delightful and inspiring, and his friendship prized by all who knew its value. He will be generally missed and sincerely mourned, and a full tide of sympathy will go out to the stricken household upon which the blow has fallen with crushing force."

High praise, and from those who knew him best. Mr. Leach was not a great man; he himself would not have claimed that, nor have allowed anyone else to have made such a claim for him; but he was genial, kind, modest and unassuming in thought and action, and honest, careful, industrious and conscientious in his work. These characteristics are those we prize most highly in

all our friends and acquaintances, and which in the aggregation of all individual effort make much that is pleasant in our lives, and tend towards making the world a better place in which to live.

He leaves a memory which we all recall with pleasure, and we can all say, without any mental reservation, we are glad that Henry B. Leach has lived, and glad that we have known him.

To Mr. John R. Lynn, the preparation of a memorial to Gov. Asa S. Bushnell was assigned. Mr Lynn spoke as follows:

Mr. President and Gentlemen of the Association:

The death of Gov. Bushnell was a matter of regret to every good citizen of the State which he had served so well in places of honor and trust. His success with the Springfield Gas Company was almost entirely due to his great executive ability, to the characteristics of the man and to the confidence of those among whom he made his home. Gov. Bushnell was, I believe, one of the original members of the Ohio Gas Light Association; he had been for many years a member of the Western and was well known, especially to those of us who have made our homes in Ohio. He numbered among his friends all of the Ohio gas men and was known for his genial and kindly spirit and his remarkable ability as an entertainer; the meetings which we have held in Springfield will always be remembered with pleasure.

I will say this for his administration as Governor of the State of Ohio for, from my boyhood, I have watched with particular interest the career of the public men of the State. I do not know of any administration that was so marked for its business ability and the general executive ability of the governor as the administration of Bushnell. His entire attention was given to the affairs of the State and it was remarked upon by the people of all classes and the people of opposite political affiliation as well that his administration was particularly marked in that respect.

His was an ideal character. He was honest and above board in all things he did. His life was an open book. Governor Bushnell was a man who would have graced any position in life. In his work he was truly excellent and though he has gone from us he has left behind him a high reputation as a patriotic soldier, a wise statesman and a successful business man. In fact, in all things truly a man among men. He was a man of singularly bright understanding. And in closing this brief tribute to his memory let me say that neither I nor any other member of this

Association or any other organization of men could give a tribute fitting to the memory of Asa S. Bushnell.

THE PRESIDENT—You have heard the report of the Memorial Committee. I am sure we all feel obligated to the gentlemen who have spoken and given us of their knowledge concerning those good friends who have gone before. I rather take it as understood that the Committee shall be instructed or requested to send a suitable communication to the family in each case. In the absence of anything to the contrary, I think that will be so assumed and carried out by the Committee on behalf of the Association.

On motion of the Secretary, the report of the Committee was accepted by rising vote.

The President called for the

REPORT OF THE COMMITTEE ON PRESIDENT'S ADDRESS,

which was read by Mr. Paul Doty:

To the Western Gas Association—Gentlemen:

Your Committee to whom was referred for consideration the President's address report as follows:

The President recommended that more consideration be given to an expression of our interest in our fellow members who have answered a greater roll call. We feel that especially, as the President recommended, it should be made the duty of the Secretary to obtain the required information for appropriate obituary notices, and that the question should be referred to the Directors of the Association with power to act. Any additional duties for the Secretary are properly within the authority of the Board. The Association as a whole, it would seem to the Committee, would not care to commit itself to a definite settled policy in the matter, but rest assured the Western Gas Association is ever mindful of its obligations and will render honor where honor is due.

It seems to the Committee that consideration of the question of the establishment of an employment bureau, or of an information bureau and also a clearing house for the exchange of idle appa- should be left to the officers of the Association with power

The Association is in hearty sympathy with the President's

appeal for good taste in gas works architecture. Too often the buildings are not what they seem. Architecture should appeal to the eye, and obviously should express the purpose of its creation. The lines of the building should convey some external conception of internal arrangement.

Your Committee has carefully read and considered the expression of the President on the matter of Association work and the plea for the unity of Gas Associations. This subject is opportunely to be presented for consideration at the Gas Congress which will assemble to-morrow. Your Committee does not wish to forestall the discussion of the subject before the Congress. In view of the fact that every Association has within itself an inherent power to create a new Association, or a united Association, it seems to your Committee it would be wise to postpone any discussion of the subject at this moment, but to pledge the Association to a consideration of the subject by the appointment of a committee by the incoming President of the Association to cooperate with a committee of other Associations, if it should develop that the Congress of Gas Associations makes the recommendations for the appointment of such committees by the various individual Associations taking part in the Congress.

Your Committee desires to express its appreciation of the splendid work of your President, and the Association is to be congratulated upon its good fortune in having so able, energetic and untiring a worker as Frederick H. Shelton.

Your Committee pledges that the obituary notice of the President will be all that he may desire, but expresses the hope that that obituary notice will not be required until long after the benevolent assimilation of the numerous Gas Associations of the United States shall have been accomplished.

Respectfully submitted,

PAUL DOTY,
HENRY L. DOHERTY,
ROLLIN NORRIS,
Committee.

DISCUSSION.

THE PRESIDENT—You have heard the report. The only thing I want to interject, before putting it to motion for acceptance or otherwise is, it seems to me the recommendation that the matter

of forming a union of the different Associations be taken up to-morrow in the Congress is an admirable one. The Congress is a convening of the representatives of all Associations, and if the ideas that I have suggested, and strongly believe in, are on lines which are to find a response, to-morrow's meeting is the place where such response naturally would be found; wherefore, if this Association should carry out the recommendation and see to it that the subject is properly discussed before the representatives of all the Associations, in connection with the paper on Gas Association work, it is a right and admirable way to handle the matter. Personally I am very glad to see the Committee so report.

On motion of Mr. McIlhenny the report was adopted and its recommendations concurred in.

President Shelton then called Vice-President Thwing to the chair and the former read his paper on

COAL PROJECTORS.

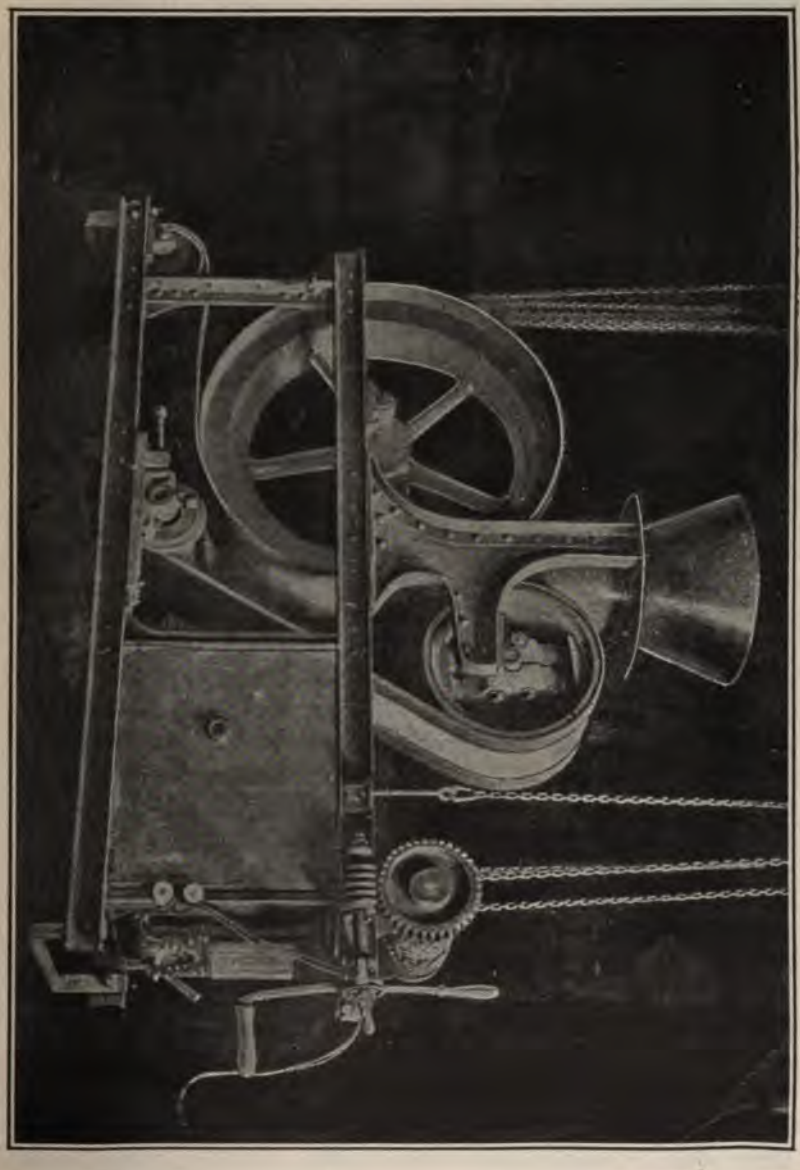
In the last year or so there has been developed such an exceptionally simple, ingenious and effective new apparatus and method for charging coal gas retorts that I believe it very desirable to herewith bring such to the attention of the members of this Association, particularly as there has been practically nothing worth while descriptive of it, so far, in the American Gas Journals, and most gas men, I believe, do not yet know of what I shall describe —viz., "Centrifugal Coal Projectors."

We are all more or less familiar with the older type of charging machinery, such as the West, the Ross, the Bronder, the Foulis, etc., machines that are wonderfully ingenious and very effective and that greatly reduce the labor cost in large retort houses. But we likewise know that as a class they practically are only warranted in large works, being ponderous, complicated and very costly. And we likewise know that some simple and comparatively inexpensive machines for charging in small works is tremendously desirable.

It looks as though such a machine has been found in the DeDrouwer coal projector, and as it is the first and best represents the principle and type of two or three forms since evolved, I will describe it first.

It is illustrated in the cut herewith, and is the invention of

Mr. J. DeBrouwer, of Bruges, Belgium. It consists of a wheel about 4 feet diameter and perhaps a foot width of face (suspended from rails overhead) in front of the benches. The rim of the wheel



has a groove in it about 8 inches wide and 4 inches deep. About a quarter of the rim is covered by an endless leather belt that presses against it and runs over 3 small guide wheels, with a tightening device; a 10-horse power electric motor is attached that runs the whole thing. The apparatus is arranged so that it can be easily raised or lowered, opposite any retort level, or pushed along to any bench to be charged. When in position it is also under a spout, leading from a continuous bin overhead, carrying the coal to be charged. Another, though less desirable form, runs on floor rails and carries a hopper with enough coal in it to charge several times without replenishing.

To operate, the attendant starts the motor, which in turn makes the belt run around, and it, pressing against the edge of the 4-foot wheel, makes it revolve in turn. In a few seconds the large wheel is running 200 revolutions a minute. The operator then pulls the lever of the coal chute overhead and the coal falls into the hollow groove of the revolving wheel. It absorbs the motion of the rim, being held against it by the belt, travels around with the rim about ¼ of the circumference, and then being released flies off by centrifugal motion in a continuous stream, straight into the retort. The stream of coal is like a stream of continuous shovelsful. It is almost like playing a stream of coal from a hose. It is beautiful. The coal is thrown clear to the back end of the retort, and builds out evenly and rapidly until the full length of the retort has been charged, 8 inches or 9 inches deep, when the operator shuts off the coal supply, pushes the machine to the next retort and repeat. The speed is equal to and even faster in some cases than that of the big, old-type machines; for the rotary projector throws in a charge of coal, say 400 pounds, evenly distributing it, in about 12 seconds. Shifting to the next retort takes about 6 or 8 seconds; 5 or 6 retorts can be charged in 1½ minutes, or 3 or 4 in a minute, in regular operation. No part of the machine is nearer than 4 feet to the mouthpiece.

The great attractiveness of the apparatus is its extreme simplicity, and the fact that it is suitable for any ordinary retort house with even only a few benches. There are no reciprocating parts, cranks, or joints to break or pound, or requiring constant adjustment or skilled mechanical attention. There is nothing but one large wheel, 3 little wheels, plain bearings to grease, a belt and a

small motor. Wear and tear is slight and easily made up. The rig weighs perhaps 2,000 pounds, and the price when on the market certainly ought to be small.

Such is the latest thing in charging machines. Invented in 1902, and used successfully in the Bruges works, it has already been put in several other Continental works and in several English works. One machine imported has been tried for some months in one of the New York stations, exciting much admiration for its work. This machine I have repeatedly seen at work. Mr. Somerville has arranged for one for Indianapolis, Ind.

The best description I have seen of it is in the *Journal of Gas Lighting*, March 24th, 1903, page 748. Lesser articles are in the same: May 12th, 1903, page 367 and May 26th 1903, page 523. Also in the *Gas World*, May 16th, 1903, page 811. The English patent (abstract) is in the *Journal of Gas Lighting*, August 26th, 1902, page 569. The American patent is No. 716,201, dated December 16th, 1902, to J. DeBrouwer. The English agents are Messrs. W. J. Jenkins & Company, Ltd., Retford, England; the American agents are Messrs. Bartlett, Hayward & Company, Baltimore, Md.

About the same time that this machine was being developed as is often the case, another apparatus was being developed, operating on the same main principle (viz., the use of centrifugal force to throw or project the coal into the retort), in Paris, at La Villette Works, by the Paris gas people. This machine takes the general form of a vertical, turbine wheel, carried in a travel-car in front of the benches, on floor rails. The wheel is horizontal with the axis vertical. It has five blades and is about 38 inches in diameter. It has no belt. It, too, is spun around and up to 400 revolutions per minute. The coal is dropped in between the blades from a feed-spout overhead, where the blades catch it and throw it in the retort, also in a continuous stream. The Paris machine is much the heavier and larger, weighing some 10 tons, but is built to carry with it some 4 tons of coal for charging without fresh supply. It uses some 20-horse power and takes about 30 seconds to get up speed and charge a 20-foot retort.

This machine is copiously illustrated and described in an article entitled "The New Parisian Retort Charging Machine," in the *Journal of Gas Lighting*, May 19th, 1903, page 429; also, May

26th, 1903, page 305. Patent abstract may be found in the *Gas World*, January 31, 1903, page 80; and a brief description, *Gas World*, December 20th, 1902, page 1003; also May 30th, 1903, pages 905, 906 and 907, where F. D. Marshall gives figures on operating cost etc.

And while the Belgians and the French were evolving these two forms of rotary or whirling machines for coal charging, a German was doing the same thing, for in the *Journal of Gas Lighting* is an illustrated, though brief article, October 6th, 1903, page 45, describing the "Kobald" charger, as made by C. Bittle of Stuttgart, and of which I have since seen blue prints. It, too, is a rotary, simple form, suspended like the De Brouwer, but using no belt, but blades instead (3) like the Paris machine. Operated also by a small electric motor, it gets its supply from an overhead bin and pushed along the retort house, also throws, into any desired retort, in a quick, uniform stream a few hundred pounds of coal in a few seconds.

There is also to be noted a centrifugal machine patent abstract to W. L. Wise, *Journal of Gas Lighting*, December 23d, 1902, page 1045; but whether this is still a new form or the English patent of one of the above machines, I do not know. Some description is given in the *Journal of Gas Lighting*, January 6th, 1903, page 39. It is on behalf of the Compagnie Parisienne d'Eclairage et de Chauffage par le Gaz.

Whatever the individual form may be, these new machines are a great step in advance. They attain: Low first cost; greater labor economy; adaptability to small works; minimum wear and tear; great capacity; great certainty of operation.

They have surely come to stay. They are absurdly simple, effective and ingenious. Skeptics have been apparently unable in the past year to show any weakness in them, or objections of any moment, beyond the fact that for their best working they require the coal to be crushed to a uniform size, and practically require some accompanying system of coal conveyors and overhead feed bins. But this latter is a good thing in any works, and the former in such a system is easy to arrange.

In the opinion of the writer, their great simplicity and applicability (by varying the speed and details) to any lengths of retort and weight of charge will sound the death knell to the older type of ponderous expensive machines. And as they reach

the same low labor cost as such machines, and as low as in inclines (and without the high and special retort houses, or special construction, or heavy cost of the latter), I believe they will have a decided retarding influence upon the growth of inclined retorts.

A model of the DeBrouwer apparatus first described has been secured by this Association for exhibit at the Exposition. I commend it and the whole subject to every manager interested in the matter of cheap charging.

DISCUSSION.

THE CHAIRMAN—You have heard President Shelton's interesting paper. It is now before you for discussion.

MR. COPLEY—I would like to ask in what station of the Consolidated Gas Company, of New York, this machine is being operated?

MR. SHELTON—At 14th street and East river.

MR. COPLEY—The engineer of the station expressed himself as being perfectly satisfied?

MR. SHELTON—Everyone whom I heard speak of it; from the Chief Engineer, Mr. W. H. Bradley, down, expressed themselves as very much satisfied with it.

MR. NORRIS—At the last meeting of the New England Association of Gas Engineers, Mr. Bradley spoke of this machine, and extended an invitation at that time to any gas man interested to come and see it work. As a matter of fact, however, I believe it is not in continuous operation, so that possibly it is necessary to make some arrangements beforehand to see the machine work. Possibly Mr. Shelton can say whether it is in regular operation now or simply in experimental use.

MR. R. M. SEARLE—Chief Bradley told me about 10 days ago that the machine was regularly operated, and very kindly said I could bring as many men as I wanted to see the machine. He is very much pleased with it. I would like to ask the cost of the machine in this country, if Mr. Shelton knows. I understand in England it costs about $1,000 to import it into this country; that it was in the hands of some bright American manufacturers, and the price was higher.

MR. SHELTON—I think it is not yet sufficiently on the market to have established any price. I don't know any definite figure

on it. Messrs. Bartlett, Hayward & Co., of Baltimore, have the agency for the machine, and they told me, owing to press of construction work, they had been delayed in getting out the plans, patterns, drafting, etc., to offer it as yet on the market.

MR. LINDSAY—As I understand the operation of this machine the coal is uniformly placed in the retort. Is that correct? How do they regulate it so as to get the same depth at the mouth of the retort as at the rear end?

MR. SHELTON—The coal is blown in or thrown in practically by centrifugal force just hard enough so that when it hits the back end of the retort it causes it to "build forward." It has not enough force to climb up over itself and block up the back end of the retort. The speed is tested, and just the right speed used as will throw the coal in a 20-foot retort, at one speed, or in a 10-foot retort at a less speed, and that permits the coal to build forward. The coal is usually handled from an individual hopper that will give just the measured number of pounds of coal desired to throw into the retort, so it necessarily follows, as the coal builds forward, that when the coal gives out it ends at the mouthpiece, when a man claps the lid on the retort. It would seem as though it would be almost impossible to charge that way and get a uniform bed such as is necessary, but the "proof of the pudding is in the eating." There is no question that the retorts are charged with great uniformity, probably a great deal more uniformly on the average than by hand charging, and at least equal to the best machine charging. In order to illustrate this, Mr. Bradley had constructed in the 14th street works a wooden retort, placed in the same position (the same height and the same distance and everything) as in a clay retort, and after blowing in two or three charges into as many retorts to show his visiting friends, he would push the machine out to the wooden retort, charge it under the same conditions, and then have "Mike" lift the lid so that all might be satisfied as to the distribution of the coal. It certainly was most uniformly distributed from the front to the back of the retort.

MR. NORRIS—I would like to ask Mr. Shelton whether, in case of the Paris machine, with retorts 20 feet long, if his understanding is that they find it necessary to slow the machine up during the process of charging, so that when it is throwing the coal 20 feet it would be running faster than when only throwing

5 or 6 feet. I understand that in a comparatively short retort the coal will slide against itself and give a comparatively uniform charge, but in case of excessively long retorts it would seem necessary, and is readily possible, to regulate by hand the speed of the machine so as to give a uniform charge.

MR. SHELTON—Mr. Norris brings out the point of proportionate speed. In the 20-foot retort the speed I imagine starts at 400, if I recollect rightly, or rather, they speed the machine up to 400 before they permit the coal to drop in to be thrown into the retort, and as it is in operation they decrease the electric power, by some suitable contrivance; so that the speed shall slow down somewhat; it falls off in speed as the retort becomes charged. It is a matter of experiment to find out the proper speed for the particular work.

MR. BAEHR—I should think one extremely good point about this machine is that you could install it in retort houses as they are to-day. The retort houses in a great many works are so narrow from the face of the bench to the wall that the standard style of large machines cannot be put in there. With this machine there would be no trouble in installing them in the space that would be found in any retort house. In my own experience, I have endeavored to put in the large charging machinery in some old retort houses, but was unable to do so on account of the length of the machine. The De Brouwer machines ought to go in anywhere, and as they are cheap, it seems to me they are very desirable as a solution of the stoking problem in the old retort houses.

MR. SHELTON—I do not happen to have personal knowledge as to the fineness of the coal that can be worked with them. They seem to take mine run coal and crush it, eliminate the large lumps down to 2 or 2⅓ inches, and then proceed without care as to large or small.

THE CHAIRMAN—Are there any further remarks?

On motion of Mr. McIlhenny a vote of thanks was extended to Mr. Shelton for his interesting and instructive paper.

REPORT OF COMMITTEE ON WORLD'S FAIR.

June 13th, 1904.

To the Members of the Western Gas Association—Gentlemen:

At the meeting in Indianapolis last year, you will remember

that the suggestion was made that it would be appropriate for this Association, the principal body of gas men in the central portion of our country, to take some part in the Louisiana Purchase Exposition, particularly in the way of providing a headquarters for gas men visiting St. Louis this year, and possibly in the way of some exhibit. A discussion of the subject resulted in the matter being put bodily in my hands, as President, with power to act.

I have the honor of reporting herewith in the matter.

Upon giving it careful thought, and after consulting numerous members of the Association, it seemed feasible and desirable that the Association make a technical exhibit of the gas industry, with the idea of such display forming as well, headquarters for visiting gas men. It did not seem wise to undertake to make a full display of all gas goods, or a "trade exhibit," it being felt that that was beyond the province of an organization composed chiefly of gas engineers and managers, and that any such line of trade goods should be for the manufacturers to arrange if they saw fit. On such lines, then, I went ahead.

It was manifestly impossible to have an individual building, the great expense involved, beyond our practical resources, being the chief reason. Application was, therefore, made for space in one of the regular buildings, and Section 33-A was allotted in the Liberal Arts Building. The amount procurable was very much less than desired, but the best that could be done. Invitations were shortly after sent out to certain gas companies and to practically all supply firms and people, to participate first (whether contributing or not), by loaning models, appliances and historical things suitable for exhibit, and second, for voluntary cash contributions as well, to create a fund to cover the expense. While all gas supply people, wherever located, selling to our membership, were invited to contribute, the invitations to gas companies were, on the main, confined to Western Gas Association members or to companies between the Alleghenies and the Rockies, the general territory of the Western Gas Association, it being the desire to have the matter, as far as gas companies were concerned, [illegible] primarily of the Western Companies.

The results of this invitation to participate were of interest, [illegible] As in many such affairs, while favoring the [illegible] in theory, the majority of those solicited, did not

practically assist by participating. It is doubtless another instance of the belief that some other fellow would do enough, and the failure to realize the need of every one joining in to make it the fullest success. As a net result out of 243 gas companies interrogated, but 45 subscribed. Of about 125 trade interests, about 52 subscribed. Our exhibit then is in reality, as far as the "sinews" are concerned, and co-operation, the work of about 97.

All honor, I say, to them; to those appreciative, broad-minded and practically helpful; to those loyal to the gas business, doing each a share towards a praiseworthy and desirable object. Honor to the small companies, such as far off Tampa, Florida, that sent contributions to help push the enterprise along, and to the up-state companies, that in proportion to their means, in many cases contributed more than some of the so-called big companies. And honor too, to those trade interests that turned to, and (without appreciable thought of especial advertising result, or advantage), without exception, almost, did all within the power of each, to promote the success of our exhibit.

Amongst such good spirit of those participating, it is perhaps invidious to comment upon any individually, yet it seems to me but just to say in particular that the meter interests have co-operated with the Association to make our exhibit a success; and in particular has the U. G. I. Company gone to large expense to lend us many and most attractive exhibits. As to the cost of the exhibit, I would report that owing to unexpected rates for piping, plumbing, carpenter work, painting, etc., imposed by those who controlled such work in the Exposition, rates three times usual costs and naturally not anticipated, but which could not be avoided, the cost had been in excess of the estimates. And the amount of money that it was thought would be subscribed, has, in fact, fallen short. These two reasons leave us at present with a deficit and some money yet to be raised to maintain and terminate the Exhibit and it is hoped that in one way or another we will be able to secure the necessary funds. Under the circumstances, any gas companies or trade interests, who have not heretofore subscribed something, and who may wish to help and show their appreciation of the Western Exhibit enterprise, will find any such subscription warmly appreciated.

A detailed report of the money collected and the expenditures is on file. In the matter there have been a few shadows. Some

have chafed that they did not have more space, or better location, or something they have not. To these I can only answer that we have had to get along at best with far less space than desired, The space in the Liberal Arts Building was over-applied for. We have but half what we asked for, and even that was in peril of being cut down at one time. We could have easily filled four times the space we have. As a result I have had to maneuver beyond measure to even partially display what was available. To cap the climax it developed that our space is over the bed of an old pond, where it was not possible to get a footing for shoring, first expected, and the Management of the Fair prohibited adding further weight or exhibits on the ground of public safety, and some exhibits, most kindly prepared and tendered, after all could not be received, and through no fault of ours. We "have had our own troubles" and it has been impossible to make a showing desired, and where I have disappointed some, I can only say that what was finally done, I did absolutely from necessity or in sincerity of belief as to the best general result, without personal or business bias, it being well known that at any rate I am free from any trade affiliation, that would influence me.

I want to record my appreciation of the attitude of Mr. J. A. Ockerson, Chief of the Department of Liberal Arts. In many ways he has extended courtesies and facilities.

The degree of success attained and result of it all, I leave to your kind judgment. It is my own opinion that while not making a national exhibit, we have, however, made a most creditable *Association* exhibit. It is replete with characteristic features of our business, is dignified and instructive. Aside from the regular articles to be expected, it contains an excellent number of novelties that must be of special interest to the watchful and progressive gas man, for instance, the De Brouwer coal projector, inverted incandescent burners, concrete purifier work, high pressure appliances, etc.

Aside from the exhibits, members and friends will find the gas display a convenient headquarters, for meeting, inviting guests, correspondence, information and other features. The attendant in charge is, specifically instructed to "tumble over himself" to any one showing a Western badge, or endorsed by a Western member, and Mr. F. R. Persons, officially in charge, and representing the Association, needs no introduction.

The Lighthouse that we have built, and tendered to the Exposition Management, I trust will be of more than passing interest, and that our serious thought will cause us to realize how well it typifies the aims of the Association and the making of the whole exhibit; our aim and purpose being that of giving light, both actually and educatively.

Personally, let me say that to make this exhibit a success, to the credit of the Association, I have labored long and hard. No one can know how many hours, days and nights I have worked upon it. Without an atom of personal thought, but wholly that it should be be a credit to the good, old Western, I have aimed to make it a Western success. It is now launched. After this meeting I return to the ranks, and in turning over this exhibit to the succeeding President, Mr. Thwing, who will inherit the charge, until the Exhibition's close, I shall be wholly satisfied, if you gentlemen, to perhaps a moderate degree, express approval of my work. Respectfully,

F. H. SHELTON,
President and Committee on Exhibits.

RFPORT OF COMMITTEE ON THE WORK PERFORMED BY PRESIDENT SHELTON RESPECTING THE GAS EXHIBIT AT THE FAIR.

THE CHAIRMAN—A Committee was appointed by the Board of Directors to prepare resolutions expressive of our appreciation of the work of President Shelton in getting together the Gas Exhibit that we have admired so much. Is that Committee ready to report? Mr. John D. McIlhenny is Chairman.

MR. JOHN D. MCILHENNY—Mr. Chairman, as a member of the special committee of our Board of Directors, consisting of Messrs. J. B. Howard, Thos. D. Miller and myself, I wish to express publicly in the meeting of the Western Gas Association some appreciation of the work which Mr. Shelton has accomplished in the consummation of the exhibit of gas appliances at the Louisiana Purchase Exposition. When the Exposition in St. Louis developed, and as it was seen that it would be a great event, the idea came to the minds of those connected with the gas business it would be most desirable that some public exhibition be made of the gas industry. A special man is needed for just such work,

and as has fortunately been the case in matters of State and of great importance, a man was found for the occasion, with the many qualities necessary, including a sincere affection for the gas industry, zeal, industry, discretion and ability to obtain the necessary funds in order to carry on the work. Mr. Shelton, at that time the incoming President of the Western Gas Association, assumed the task, and to him we say the entire credit is due. He has performed an enormous amount of work. He has issued a tremendous quantity of literature, and the result is you have a very creditable gas exhibition, the best one in any general public exposition held in the United States. I understand he was unable to obtain the space desired; in fact, that the space allotted was only about one-third of that requested, owing to the fact that the applications for room in the Liberal Arts Building exceeded by several times the amount of space. Many difficulties were also encountered from the beginning. One difficulty was to arrange the exhibits to properly show them in a small space; another, in having the work finished, owing to delays due to scarcity of labor and to labor unions, etc., in St. Louis. This latter made the work more expensive than was anticipated. I want you to see the exhibit for yourselves, and I think you will join me in saying it is most creditable and instructive to those in the gas business, and at the same time it shows the public that the gas business is a profession of the highest order. I think gas companies as a rule have overlooked the importance of educating the public to a fitting recognition of the ability and qualities necessary to the gas business. The average citizen stands in admiration at the exhibition of electricity in its various forms, knowing that it requires wonderful and exceptional ability; but he does not think about the gas business in the same way for he knows nothing of it. Our citizens should see something of the gas business, and should know that gas is not merely pumped from the surrounding atmosphere. They should know that great quantities of materials, complicated apparatus and skilled labor are necessary. President Shelton is entitled to a great deal of credit. Your Directors have been very glad indeed to appoint a committee to make public expression of this fact, and I move individually that the Association hereby express its deep appreciation of the most successful services of Mr. Shelton in connection with this exhibit. (Great applause.)

THE CHAIRMAN—We would be glad to hear from any other gentleman who feels that Mr. Shelton's efforts should receive further appreciation. We all know he has worked very hard.

Mr. DOTY—I simply desire to say, having in mind Mr. Shelton's evident interest in obituaries, that in St. Paul's Cathedral, London, on the splendid English memorial designed by Sir Christopher Wren, and where his monument is, there is inscribed: "If you would see what he has done look about you." It seems to me the gas exhibit of the Western Gas Association will be a memorial to Mr. Shelton, and while we hope he will not yet be buried in St. Louis, we can truly say, if he wishes a memorial, we can do no better than to look at his exhibit and say as we look around it this is what Shelton has done; by that work we shall know him.

MR. BOARDMAN—I wish to say I have observed Mr. Shelton's course since he first became a member of a gas association. This achievement is merely the last step in a progress that has been continuously upward. He has been throughout it all a conscientious worker and a liberal contributor to our knowledge and our pleasure, and I am satisfied that, however great the achievement at present, we are bound to see still greater in the future. I join most heartily in seconding the motion for a vote of thanks for this particular endeavor.

A rising vote was thereupon taken upon the motion to tender a vote of thanks to Mr. Shelton, and the same was unanimously carried.

MR. SHELTON—Gentlemen, I can only say that listening to Mr. Boardman was pretty near like hearing one's own obituary. But I would say this. What you have said is worth a heap sight more than all the obituaries you may stick up later. What I have done has been done from the heart; it was a labor of love. The Western Association has been nice to me, and I have tried to be as nice as I could in my work; in my acts, in return. As to this matter there has been a good deal of detail, a good deal of hard work, a good many disappointments. I shall not take up your time this afternoon by going into details, for it is in my report of 4 or 5 pages that was reported to the Board of Directors yesterday, and you will find printed in the archives of the meeting. I think that is probably the best way to leave it. I can only say that what I have done was done sincerely, and I thank

you for your appreciation of whatever measure of success I have reached. I hope you will be lenient in criticism of what mistakes we have made, for they are practically inevitable in a work of that kind. Gentlemen, I thank you.

The President then resumed the chair and the report of the Auditing Committee was received, accepted and ordered filed.

THE PRESIDENT—I will call upon Editor W. E. Steinwedell to present the budget which he has collected for the past year on account of

THE WRINKLE DEPARTMENT.

No. 1.—*Operating with Choked Gas Nostrils in Benches.*—Mr. G. Falkenstein writes from Cooperstown, N. Y., that he once operated 22 benches of sixes (presumably for the coke) and having a great excess of gas it was first used under boilers and

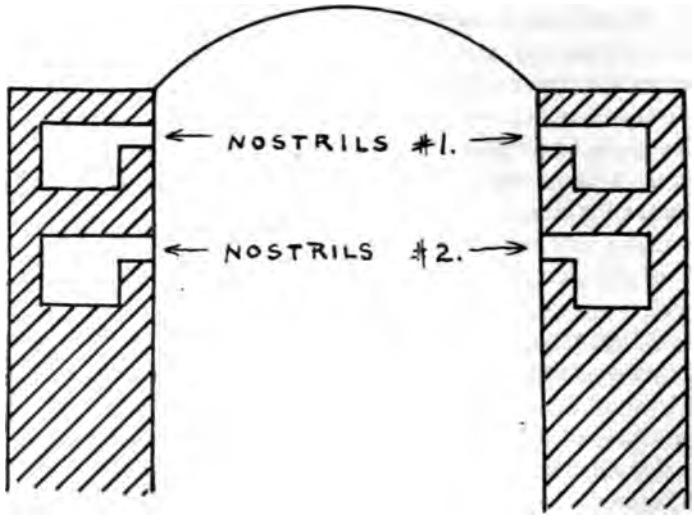


Fig. 1.

later in benches. Two flues and sets of nostrils were provided, one above the other, as in Fig. 1, and the gas run into one flue for about 6 hours, or until the nostrils were partly choked. The gas was then shifted to the other flue for about 6 hours, and in the meantime the first set of nostrils cleared again. The heats were steady and very even.

No. 2.—*Exhauster By-pass in Vertical Pipe.*—Mr. G. M. Averill has an automatic exhauster by-pass in Cedar Rapids, Ia., located in vertical position, as shown in Fig. No. 2. The weight *W* is slightly greater than that of the 2 "wings" of the butterfly and the valve gives perfect satisfaction.

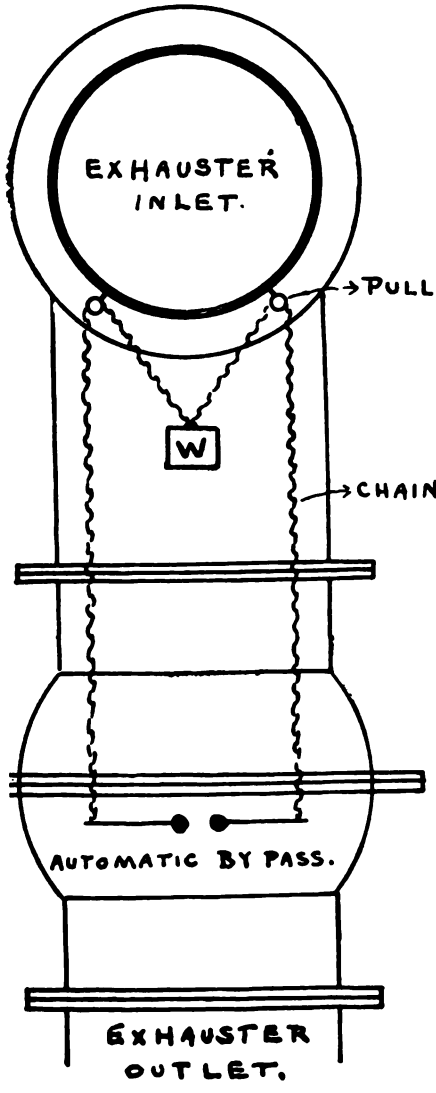


Fig. 2.

No. 3.—*Safety Alarm for Relief Holder.*—The blowing of the relief holder involves a loss of gas, and if the exhauster runs after the holder has landed a more serious loss results. Mr. W. E. Hartman, of Joliet, Ills., writes that to prevent either of the above, a steam whistle is connected to the top edge of the relief holder with a long, flexible wire cable, Fig. 3. The cable runs between a pair of small pulleys on a block fastened in the middle of one of the holder columns, and a sliding weight is hung on the cable between the pulleys and the holder to take up slack. By adjusting the length of the cable properly it will blow the whistle when the holder is one sheet from blowing or one sheet from landing. The whistle should be blown by hand every noon as a test.

No. 4.—*Method of Excavating Holder Tank.*—Mr. L. L. Kellogg, of Sioux City, Ia., describes the following for a holder tank

96 feet in diameter by 26 feet deep; holder of 425,000 cubic feet capacity. The first 8 feet was a sandy clay. The next 15 feet was a water bearing quicksand, under this was blue clay. The tank is located very close to the electric light plant and the

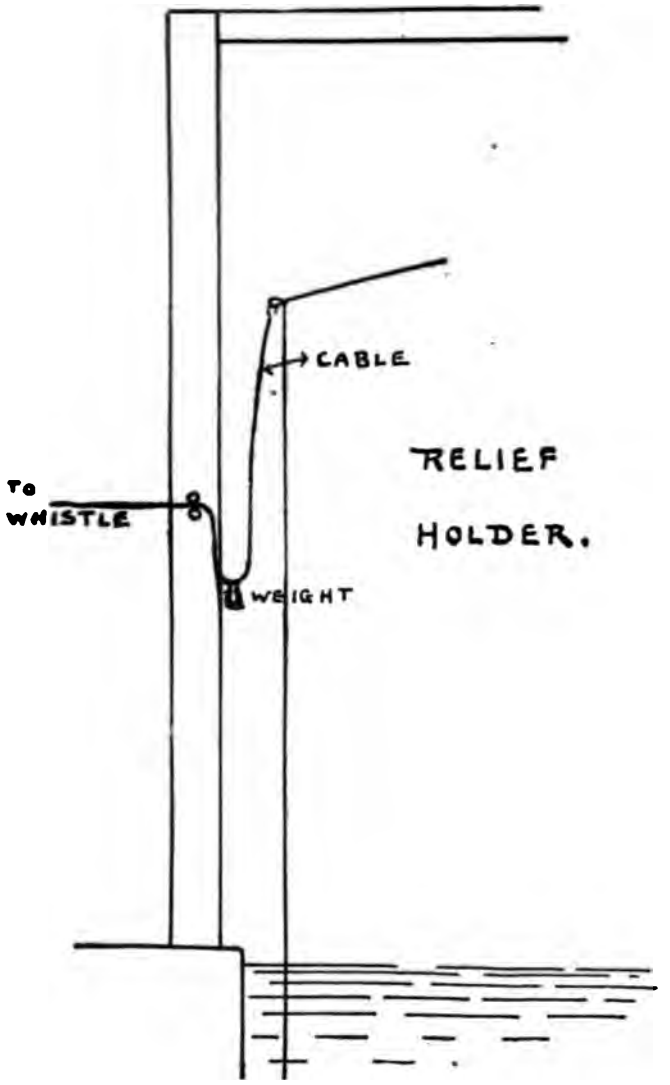


Fig. 3.

problem was to excavate without endangering the electrical foundations, as the tank was too close to allow the tank to be sloped. After the first 8 feet had been excavated, the circle of the wall was laid out, and 3 inches by 12 inches by 18 feet sheet-

Fig 4.

ing with the ends sharpened flat-wise was driven on both sides of the wall around the two circles. The excavating was then continued between the 2 rows of sheeting, and timbers put in to hold

the sheeting about 10 feet apart. A concrete footing was put in the blue clay, and as the wall advanced the timbers were removed and the space between the wall and sheeting tamped with earth. Fig. 4 shows the sheeting, timbers, tank wall and the earth in the center, which remained until the tank wall was above the top of sheeting. The inside of the tank was excavated by the use of an electric conveyor which dumped behind the wall or into wagons.

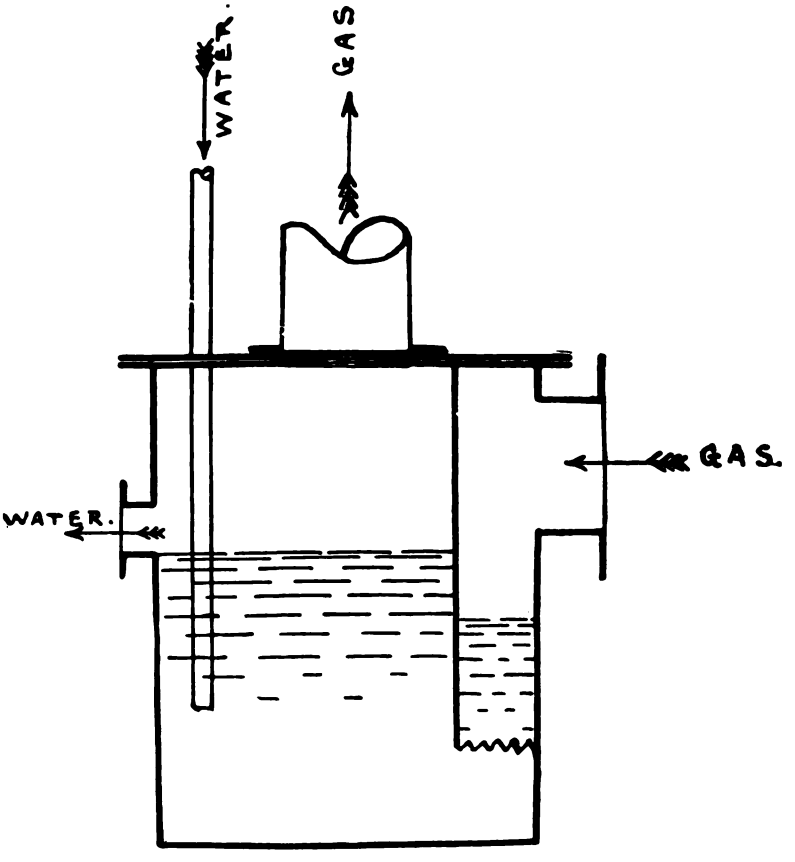


Fig 5.

No. 5—*Safety Blow Off.*—In using purifiers with dry lutes there is no large vent for back pressure as is the case when wet lutes are used. A safety blow-off, as shown in Fig. No. 5 should

therefore, be connected with the inlet to the purifier, so that the seal will blow at slightly less than the seals in the works. Water enters continuously through the pipe from above, and overflows on the side. This waste water can be used in scrubbers or condensers if the pot is placed high enough in the works.

No. 6.—*Portable Gauge for Detecting Leaks.*—The accompanying, Fig. 6, sent by Mr. Thos. D. Miller, of New Orleans, La., represents a portable mercury gauge which will be found convenient

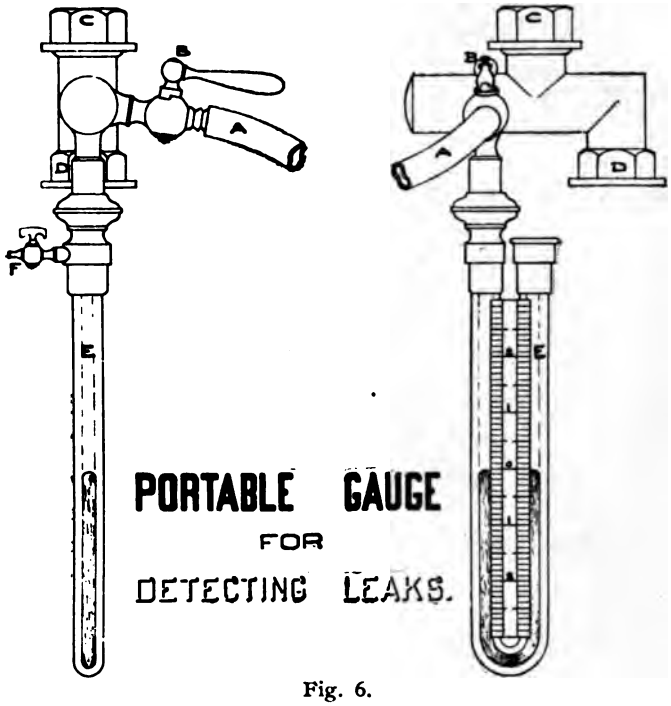
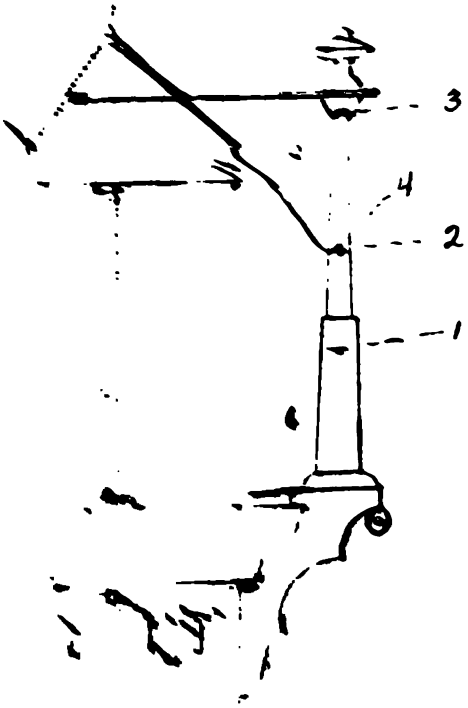


Fig. 6.

for testing for leaks in meters, piping and fixtures, either in place or in shop, in absence of a pressure holder. Attach the gauge either at *C* or *D*, open the cock *B* and blow in rubber tube *A*. A pressure of 5 inches of mercury can be readily obtained. Closing the cock *B* and observing the gauge the slightest leak will be readily observed. It was designed by the Meter Repair Department of the New Orleans Lighting Company, Lessee.

No. 7.—*Meter Prover Alarm.*—This device is arranged on a meter prover to give warning when it is time for the operator to

[illegible] so that he can be doing other work while the [illegible]. Fig. No. 7 shows a cheap and simple arrangement [illegible] satisfactorily. Numbers 1, 2 and 3 are small [illegible] the small, round tins that come on [illegible] to a small wire nail. No. 4 is a small weight made from a piece of solder and copper wire, this should not weigh over ¼ ounce so as not to scar the prover. No. 5 is a string 13 inches long, one end made fast to the prover, the other tied to the weight. No. 6 is a piece of tin about 2 inches square, secured by screwing the stanchion down on it. This to act as a sounding plate. On a 5-foot prover the height of the shelves should be about as follows:



No. 1 should be 15½ in. above No. 6
No. 2 " 20¼ " " 6
No. 3 " 30 " " 6

If when the prover is full you want to run 5 feet through, say a 10-light meter, put the weight on No. 1 when the scale shows about 4.7 feet run out, the string will put the weight off, it will strike on the tin at No. 6, making a noise that can be heard about 20 feet. Nos. 1, 2 and 3 should be set parallel to the side of the prover nearest the stanch- [illegible] will not catch on the other shelves when [illegible]. Highlandtown, Md.

[illegible] *Schools.*—Mr. B. W. Perkins [illegible] shown in Fig. No. 8, of the Department of [illegible] Ind. This is studied by the

pupils in the eighth grade, each of whom is provided with a perfect equipment for cooking, including a gas hot plate and oven. The teacher has a regular gas range and every conven-

Fig. 8.

ience is at hand for practical work in this course. It is certain that children thus appreciating the value of gas for fuel, will tell their parents of the gas stoves and also "cook with gas" themselves in after years, on account of its efficiency and economy.

No. 9.—*Temperature at Different Depths in Steel Holder Tanks.*—Mr. Geo. H. Waring, of Omaha, Nebraska, writes that ice formed on the side of the tank 13 feet below the surface of the water, which was free from ice. Pint bottles filled with water and corked were hung at different depths for 12 hours. They were then drawn to the surface quickly, one at a time, and the temperature of the contained water found to be within one degree of the temperature of the water in the tank at the depth bottle was hung. Care should be observed that the flange on the curb of the bottom section will not strike the bottles.

DISCUSSION.

THE PRESIDENT—Gentlemen, discussion is now in order on any of the nine topics broached.

MR. NORRIS—Regarding Wrinkle No. 5, the question arises as to what becomes of the gas in case the safety seal blows. In the case of a water gas plant the problem is a simple one, for all that is necessary to do is to pipe the safety seal so that it will discharge into the inlet of the exhauster, and in case the seal blows the exhauster simply pumps the gas around and no gas escapes into the atmosphere. In the case of a mixed gas works, where there are separate exhausters for the two gases, the relief seal of the coal gas exhauster can be piped so as to blow into the relief holder, or into the inlet of the water gas exhauster. In the case of a straight coal gas works, it is, of course, necessary to blow the excess gas into the air; or a direct connection could be made to the storage holder, and should the seal blow, in such case a certain amount of foul gas would go directly to the storage holder. A simpler construction of this device than that shown in the sketch is that of the ordinary washbox in which the dip-pipe goes through the top of the box, which does not involve any complicated castings.

MR. T. D. MILLER—One wrinkle here, No. 7, to give the alarm when it is time to read the meter and stop the power, is a very ingenious and simple arrangement, but I do not find any provision for giving an adequate alarm when the man is hard of hearing. In such case you would have to put an electric alarm on it.

EDITOR STEINWEDELL.—An electric attachment was described in the Wrinkle Department of the Wisconsin Association.

THE PRESIDENT—I would like to ask (in connection with Wrinkle No. 5) to what extent dry lutes are being adopted for purifier work. It is my observation that dry lutes are growing. I have used them in 3 or 4 instances myself, doing away with the old wet seal, rusting sides and blowing cups. It seems to me now that dry lutes have started they are almost bound to grow. Is that the observation of some of the other members?

MR. DOTY—I can say the Detroit City Gas Company has two installations of purifying boxes with dry lutes, one at Station "A," the other at the Delray Station; also several installations of these safety blow-off seals. At these plants the escaping gas if any is allowed to vent itself into the atmosphere. I do not recall that this escape is at all frequent. Mr. B. O. Tippy, superintendent of manufacturing at Detroit, is in the room, and I am sure he will tell you about it.

MR. B. O. TIPPY—Our safety seals are ordinary water gas washboxes, the discharge pipe leading the escaping gas outdoors. We selected a place for the discharge where it would be safe for it to blow, and at the same time where the escaping gas could be quickly discovered.

MR. FULKERSON—I would like to ask someone better posted than I am to give me a cause for the flooding of those seals, if the plant is properly attended to.

THE SECRETARY—I would suggest possibly you might have sustained a stoppage of the inlet to the holder by naphthalene.

MR. FULKERSON—Could not that be attended to in time without any sudden stoppage?

THE SECRETARY—I don't know; perhaps it could if the superintendent thoroughly understood the technical as well as the practical side of his business, and could foresee all difficulties that were likely to arise. If he were infallible probably that could be done.

A MEMBER—I do not agree with the gentlemen on that point, although I am open for argument; but I will say that in five years' observation I have not had a blow. I am using a dry seal and a Chollar purifier, and I have had no blows whatever, although I have provision made to take care of them. They told me I should have provision made for blows but I have experienced none.

MR. T. D. MILLER—How long do you leave your oxide in?

A MEMBER—My oxide has been running 18 months.

MR. FULKERSON—I have never had any back pressure in 5 years sufficient to blow seals. Those troubles likely to arise are looked after every day and taken in time.

MR. NORRIS—In this connection I would like to say I have heard of people carrying life insurance for more than 5 years without dying—but that is not what I got up to say. I want to call your attention to the fact that these safety devices, which are in my judgment undoubtedly useful in certain cases, may be made with very much smaller connections than the regular yard connections around the works. For instance, an 8-inch pipe and an 8-inch safety seal will pass a great deal of gas, and would probably take care of works with 16-inch connections, provided the connections of the 8-inch seal are sufficiently short.

MR. T. D. MILLER—We had two boxes, and in that time, when in the largest year's make we had somewhere in the neighborhood of 40,000,000, we never had a dirty box. A change of boxes was necessitated by an increase of pressure caused by the sponge packing from being in the box so long, and while we did not have any gas to blow out our lutes overflowed and gave a warning to us and we would get at the box. Mr. Norris's remark is appropos, that he might have been using it for 5 years and it had not happened, but he may have a telegram reach him before he leaves here that he has had a blowout.

MR. J. R. LYNN—In an experience dating back through many years, I have made more changes of purifying material because of oxide packing than from all other causes. Under such condition we had an unusual back pressure, and I do not think there are very many here who have not had similar experience.

On motion of the Secretary, a vote of thanks was extended to Editor Steinwedell for his labors in editing the last wrinkle budget. In putting the question the President said: It gives me great pleasure to put the question to a vote, because as Editor of the Wrinkle Department for some years I know something of the labor required. The stock of Wrinkles has been largely added to, but the supply does not keep pace with the demand.

THE SECRETARY—I have something to add to that. In addition to the labor of Mr. Steinwedell as Editor of the Wrinkle Department, the presentation of which you have had to-day, he in the last year compiled and edited the publication of Wrinkles of all the Associations, from the years 1890 to 1900, inclusive.

It was a book approaching something like 600 pages. It was mailed to all the members of the Association, and from a perusal of them you will have an idea of the immense amount of effort of a thorough and painstaking sort that was required of him to do in his work in the past year, so that a more than usual hearty vote of thanks is due to Mr. Steinwedell.

THE PRESIDENT—The Secretary amends his motion, therefore, to the effect that we give Mr. Steinwedell a more than usually hearty vote of thanks and appreciation. I think when we remember that volume of Wrinkles he compiled and put together in united shape (and it has many good points), whenever we have an evening off and need something to do, we can examine that volume all the more to the appreciation of what Mr. Steinwedell has done.

RESIGNATION OF EDITOR STEINWEDELL.

The Secretary read the following letter of resignation as Editor of the Wrinkle Department by Editor Steinwedell:

MR. JAS. W. DUNBAR, Sec., Western Gas Association: I hereby tender my resignation as Editor of the Wrinkle Department of the Western Gas Association, to take effect at the meeting in June, 1904.

The co-operation of the members and others in assisting this Department has been greatly appreciated and I thank them for the cheerful support offered. Yours very truly,

W. E. STEINWEDELL.

THE PRESIDENT—Last year I think Mr. Steinwedell resigned; he is still with us. I think this year he means it, and I think it is only fair that his resignation be accepted, as seems to be his wish, and the election of his successor will fall in with the election of our officers which we will take up in a few moments. Shall the resignation be accepted as it stands?

On motion of Mr. Norris, duly seconded, the resignation of Mr. Steinwedell as Editor of the Wrinkle Department was accepted with regrets.

PRELIMINARY VOTE OF THANKS.

MR. T. D. MILLER—Before we go into the election of officers, there is a little matter that has been customary, not because it is customary, but because I feel in this particular instance it is not

...[illegible] but will be heartily indorsed by everybody, as ...[illegible] events cast their shadow before." I am sure everyone ...[illegible] perfectly willing and anxious to vote an unusually hearty ...[illegible] thanks to the Committee of Entertainment who have had ...[illegible] the local entertainment of this meeting of the Western ...[illegible] Association; and I, therefore, make such a motion.

...[illegible]

THE PRESIDENT—Certainly no other motion will give us more ...[illegible] to vote upon than that to show our appreciation of the ...[illegible] work of the local committee. They have had an unusual ...[illegible] people to take care of; they have had a complication ...[illegible] arrangements arising from two organizations, two bodies of ...[illegible] meeting, the Western to-day and various representatives of ...[illegible] associations to-morrow and next day. And they have had ...[illegible] conditions connected with the Exposition here to ...[illegible]. I suppose the gentlemen here and the public gener- ...[illegible] appreciate the difficulty of putting these things through in ...[illegible] shape during an exposition year and it is with special ...[illegible] before you the motion for action showing our ...[illegible] of the work Mr. Cowdery and his able assistants, ...[illegible] some of them! They have done valiantly. The ...[illegible] made and seconded and is before you for action. Those ...[illegible] vote of thanks to our good local friends here who ...[illegible] good care of us will say aye.

...[illegible] was unanimously carried.

THE PRESIDENT: The man who dares to vote to the contrary ...[illegible] his head.

ELECTION OF OFFICERS.

...[illegible] then proceeded to the election of officers for ...[illegible] which resulted as follows:

...[illegible] O. O. Thwing, St. Louis, Mo.

...[illegible]-Mr. Paul Doty, St. Paul, Minn.

...[illegible]--Mr. K. M. Mitchell, St. Joseph, Mo.

...[illegible]-Mr. J. W. Dunbar, New Albany,

...[illegible] years)—D. R. Warmington, Cleve- ...[illegible] Schmidell, Cleveland, O.; W. A. Baehr, ...[illegible] Washington Clark, Philadelphia, Pa.

...[illegible] year)-H. L. Doherty, New York City.

SOME RESPONSES.

MR. THWING—Gentlemen, it would be impossible for me to tell you how I appreciate the honor that you have done to me. Words would not be adequate. You know I love the Association in all its workings. That is enough to say.

MR. DOTY—Gentlemen, I am deeply appreciative of your courtesy in bestowing upon me the honor of the election to be your Vice-President. I hesitate to think myself worthy of this mark of your favor. I know the splendid work that has been done by those who have been officers of your Association, and their inspiration leads me on to hope that, with your assistance, I may be successful in furthering the good work of the Western. The phrase "Captain of Industry" is a very common one just now. It is something nice to roll around one's tongue. In Mr. Shelton you have a true example of a Captain of Industry. He is a leader of men. You have selected this year Mr. Thwing to be your Captain of Industry, and I may say you have chosen me to be your Lieutenant of Industry. I assure you it will be my pleasure to work as Mr. Thwing's lieutenant to further the work and advance the interests of the Western Gas Association.

PROPOSING A CHANGE IN ELECTION POLICY.

MR. DOTY—Before we adjourn, Mr. President, it seems to me the Association should give some thought to the value of its time in these conventions. At the least calculation, this meeting probably costs $10,000, paid in the expenses of the delegates in attendance. Assuming a 6-hour session, it would make the expense per hour over $1,500; 60 minutes to the hour would make the expense $25 per minute. It seems to me this method of election by convention balloting, although democratic and popular, could be changed without sacrificing any of the freedom of the ballot which has become the settled policy of the Western. May I suggest that this matter be referred to the Directors, with instructions to report at the next meeting on a plan that will be practicable to secure a popular election of officers with the least expenditure of time on the floor of the convention. I am sure the Directors can be entrusted to devise a plan that will not only give the fullest opportunity for the expression of the desires of

the members, but at the same time expedite the work of the convention, and also avoid any nomination by committees having in mind the perpetual selection as officers the friends of the committee. The latter practice the Western will not tolerate. So I move you, Mr. President, that the Board of Directors be and they hereby are instructed to prepare and submit to the next meeting of the Association a plan under the constitution whereby the election of officers by ballot can be more expeditiously carried out, and still provide for a full and free expression of the desire of the members in the election of officers.

MR. CHOLLAR—The by-laws provide that officers shall be elected by ballot only. All we have to do is to appoint nominating committees to select officers. It requires no action at all by the Association. The by-laws are all right in either place.

MR. COPLEY—This method was changed at the Cincinnati meeting in 1897 or 1898. It was changed back after that convention, and the present method has since obtained. It was the sense of the Association at that time.

THE SECRETARY—I do not believe the method of electing officers can be changed except by changing the by-laws. Mr. Doty's motion directs the Directors to formulate a plan and report; there is nothing wrong in that. I second the motion. I am not in favor of changing the method, but I think that is the best way.

THE PRESIDENT—The motion is to refer the matter to the Directors to formulate a plan and report to the next meeting of the Association, when the Association can reject or adopt it as it sees fit. [Adopted.]

On motion the following paper on

THE VENTILATION OF GAS RETORT HOUSES.

by Mr. Alfred Lotz, of Chicago, was taken as read, and ordered incorporated in the proceedings.

The various branches of engineering each have their particular and peculiar problems to be solved. Some of these peculiar problems are solved in different ways by different engineers, under whose notice they chance to come, as follows:

Some figure out to a nicety just what size and style of apparatus is going to give them the best results, basing their

assumptions and calculations on theory. Others will make a guess at what they think looks plausible and should do the work, and the last class of engineers base their calculations on extensive practical experience coupled with theory, and a large percentage of that factor in all branches known as "common horse sense." This latter is the class of engineers the world over who are most successful.

I have been directly connected with the various branches of engineering, including electric, mechanical, hydraulic, and, at present, with pneumatic, as pertaining to heating, ventilating and drying, and in no other branch is that valuable factor, experience, more necessary than in heating and ventilating engineering. In the ventilating branch, especially, it is a sad but true fact that the great majority of so-called engineers are prone to make definite assertions with bold front, with no actual experience or knowledge to back them up, and in laying out a ventilating plant for a specific purpose will rely entirely on their ability to make a good guess, and as a natural consequence, often come to grief, both as regards themselves and customers.

The problem of ventilating a building used for any specific purpose is rather more complicated than would appear on the surface. It is easy enough for an engineer to say an air change of once every minute or two will give the proper results, but that is not all that must be taken into consideration.

For instance, suppose you have a large kitchen with ranges which are generating considerable steam, there is really no way to figure out a ventilating plant on any prescribed formula, and it resolves itself into a matter of experience only as to how often the air should be changed to give the proper results.

Again, we have a large paper and pulp mill. Here at least we have a definite basis for our calculations. We know how many tons of dry material they wish to produce per day of 24 hours. We know what percentage of water this material holds when in a wet state, and also know how much is evaporated per hour, which in even an average mill is quite considerable. On cold days especially this moisture condenses as soon as it is formed, and the entire room is filled with the vapor so that one cannot see a distance of four feet. To try and remove this vapor by means of a fan only is almost a practical impossibility, and it is consequently necessary to blow heated air into the room in such

quantities that the moisture will be taken up and held in suspension by same. Then, by means of a ventilating fan, connected with hoods over the machines, the moisture laden air is removed from the building, the moisture becoming a vapor the instant it comes in contact with the outside air. By this means the atmosphere in the room is kept practically clear.

Every gas house manager and superintendent is only too familiar with the very objectionable features connected with the old time method of quenching hot coke from the retorts, the delay in handling it when quenched, the deterioration of ironworks in the building, and the danger to the working force, as well as the inefficiency of same, all due to the accumulation of steam and gases arising from the coke, and the inability to get rid of it in anything like a reasonable time.

Many schemes have been resorted to in order to overcome this difficulty, but none of the older forms have given anything like desirable results. In retort houses where half-depth benches are used, the coke being drawn directly on to the charging floor and quenched, the natural ventilation due to a high roof is depended on, and if external atmospheric conditions are favorable the results may be more or less satisfactory.

But where either half-depth or full-depth benches are used in connection with a separate charging floor, the coke being deposited underneath this floor and quenched there, the ventilation becomes a very serious matter. I have been in some plants where this room was connected with large stacks running up through the charging floor and through the roof above, another had a trough suspended at the ceiling, and which trough was connected with a large steel plate pan, the trough, of course, having a certain number of openings to act as intakes for the system. Another plant (Minneapolis) had a large disk ventilating fan placed at each end of the retort house underneath the charging floor. This fan was 60 feet in diameter, and when running at 300 revolutions per minute was handling 63,000 cubic feet of air per minute, requiring 8-horse power engine capacity to drive it. This latter was the best arrangement, as far as the results were concerned, and it may be interesting to give it a little closer attention.

There were 22 benches of 9's, the entire stack being 11 benches long and 2 deep, the benches being placed back to back. The

room below the charging floor was 180 feet long, 65 feet wide and 11 feet high, making a total of about 130,000 cubic feet; allowing for the space occupied by the stack, which amounted to 33,000 cubic feet, we have left 97,000 cubic feet. The fan capacity, as above stated, was 63,000 cubic feet per minute. This would give an air change of once in every 1½ minutes approximately. The natural conclusion would be that the room ought to be perfectly free from steam and gases in 1½ minutes after the quenching was completed. The actual results, however, were far from that, the reason being that there were always more or less windows and doors open near the fan, and the air would rush in from these, supplying the fan with all the air it could handle and short circuiting that part of the room which really needed the ventilation most.

The only possible way to have accomplished a complete removal of the steam would have been to have the air replacing that which was exhausted by the fan enter at the farthest point from the fan and keep all the windows and doors, as well as all openings between rooms underneath and above charging floor, closed, which, of course, is not to be thought of in a retort house.

We will now take up a ventilating system recently devised by a firm of ventilating engineers of Detroit, Mich.

About October or November of last year the Detroit Gas Company, Mr. B. O. Tippy, Superintendent, laid the proposition of ventilating its retort house before the engineers in question, and the problem was gone over and looked into very carefully. At about the same time we received a request from Mr. Douglas, Manager of the Ann Arbor (Mich.) Gas Company, asking us to look into the subject as pertaining to their plant. This latter was taken up by the writer personally.

There were many questions which presented themselves, and I daresay, with all the vast experience we have had along other of manufacturing plants, the proposition of ventilating a gas retort house successfully was an experiment with us, as well as with the gas company. However, two systems were devised which have been covered by letters patent and installed, one in the Detroit plant, the other in the Ann Arbor plant. In actual principle the plants are the same, though in construction they differ very materially, and I will only give a description of the

one at Detroit, which was finally decided on as the standard of design and construction for all future plants.

Underneath the charging floor, and running the full length of the stack, is suspended a hopper made of reinforced concrete construction, and heavy structural and sheet steel. This hopper is suspended from the I beam forming a part of the construction of the charging floor. About 6 feet of head room is left between the bottom of the hopper and the floor of the coke discharge room. The front of this hopper is provided with heavy sheet steel doors, one door for each set of retorts, a set constituting the retorts in the same vertical plane. For each door is furnished a water spray for quenching the coke. The end farthest from the ventilating apparatus is closed only enough so as not to allow the coke from the last set of retorts to fall out of the hopper.

At the other end of the hopper a large, heavy sheet-steel flue connects with the inlet of a ventilating fan. From the discharge end of the fan a steel flue runs through the outside wall of the retort house, which conducts all steam and gases arising from the process of quenching the coke into the outside atmosphere.

The fan is driven either by direct connected steam engine or an electric motor. The fan and engine can be placed in any convenient corner and out of the way. In the Detroit plant it is placed underneath the charging floor, whereas in Ann Arbor, Minneapolis and elsewhere, it is placed in one corner on the charging floor. The question will naturally arise: "How do you know how much steam and gas arise from the process of quenching hot coke with water, and how would the size of the apparatus vary with the different sizes of retort houses?" This is a very simple matter when thoroughly understood, and leaves absolutely no room for guesswork, but resolves itself into a definite train of calculation, that may be roughly summed up as follows:

We will take a stack consisting of a series of full-depth benches of 9's. The maximum amount of coke that will be drawn at any one time will be that taken from three retorts of one bench multiplied by the number of benches, and, knowing the amount of coal charged into each retort, we have the total amount of coke discharged. As the time consumed in quenching the coke is very short compared to the time elapsing between the drawings this latter does not come into the calculation. Coke leaves the retort at a bright cherry red heat, which is about 1,800° F., and

we know from definite engineering data that it takes a certain number of heat units to raise a pound of coal to its equivalent in coke to that temperature, and that this coke when cooling will give off the same heat it has absorbed. Taking the specific heat of coke at that temperature we can figure back how much water is necessary to absorb the heat given off by the coke. From this we can figure the number of cubic feet of steam and gases resulting, and allowing a co-efficient deduced from experience for the additional air necessary to absorb the moisture, we have the total number of cubic feet of gases to be handled by the fan. The vacuum at which this fan must work is dependent entirely on local conditions, and varies from ½-inch water gauge to 3-inch water gauge, and must be figured to conform with the individual lay-out. The power required by the fan is dependent on the total number of cubic feet of gases handled per minute, and on the vacuum necessary, which will vary anywhere from 6 to 20-horse power. The operation of the system is as follows: Just before the coke is drawn the fan is started up and a current of air rushes through the hopper. The coke is then drawn and allowed to fall into the bottom of the hopper. Just before drawing the coke, however, the water is turned into the spray pipes. The quenching starts the instant the hot coke and water meet, and the steam and gases arising in consequence are caught by the current of air in the hopper and taken out of the building through the fan. After the coke has been thoroughly cooled the water is turned off and the coke allowed to remain in the hopper for about 5 or 10 minutes while the fan is still running. The air now going through the hopper is perfectly dry and permeates every particle of coke, thus absorbing all water left and thoroughly drying out the coke, making it marketable the minute it leaves the hopper, a feature which has never before been accomplished, and one which will save hundreds of dollars for the gas company, and would pay for the installation of the system in a very short time, thus making the outfit a profit earning device.

Another valuable feature of this system is the fact that it can be used advantageously in connection with an automatic conveyor system. After the coke is quenched and dried in the hopper it is drawn out and allowed to fall into the conveyor, thus obviating the necessity of quenching the coke while in the

conveyor and thereby causing an undue deterioration thereof. This in itself is a very important factor, as a conveyor system is very expensive, and it has been stated to the writer that some gas companies have charged as much as 60 per cent. of the cost of the conveyor against it for depreciation for one year. From this it is evident that, if a conveyor were handling dry coke instead of being subjected to the intense heat of the coke as it leaves the retort, and then to the destructive and corrosive action of the hot steam and gases due to the quenching, the life of the conveyor will be greatly prolonged and its depreciation materially reduced; and a great saving for the gas company will be the result.

THE NEW MEMBERS ELECTED

were:

Active.

Andrew, J. C., Denver, Col.
Aldrich, Spokane, Wash.
Adams, H. E., Stockton, Cal.
Ames, K. L., Benton Harbor, Mich.
Barbour, G. H., Detroit, Mich.
Beyerle, W. P., Council Bluffs, Iowa.
Busch, J. L., Decatur, Ill.
Bixby, H., Quincy, Ill.
Britsch, M., Chicago, Ill.
Clabaugh, G. W., Omaha, Neb.
Clark, J. C. D., St. Louis, Mo.
Cobb, O. P., St. Louis, Mo.
Calkins, W. B., St. Louis, Mo.
Cornish, R. C., Milwaukee, Wis.
Cocke, J. T. B., Birmingham, Ala.
Chubb, C. W., Kansas City, Mo.
Cutcheon, M. H.
Colvin, T. E., Muncie, Ind.
Deane, E. M., Vincennes, Ind.
Dunbar, Geo. L., St. Louis, Mo.
Evans, C. B., St. Louis, Mo.
Fisher, D. J., St. Louis, Mo.
Fowler, B. C., Richmond, Ind.
Fulkerson, St. Charles, Mo.
Griffith, J. L., Sedalia, Mo.
Hassenbrush, St. Louis, Mo.
Holman, C. L., St. Louis, Mo.
Hood, J. E., Knoxville, Tenn.
Jones, J. O., St. Louis, Mo.
Kay, Jno. M., Chicago, Ill.
Kraft, R. P., Milwaukee, Wis.
Law, A. R., Durham, N. C.
Lyons, B. F., St. Louis, Mo.
Leamy, Alan, Pittsburg, Pa.
Moran, G. N. Sedalia, Mo.
Markhus, C. G. F.
Miller, W. B., Augusta, Ga.
Marshall, F. L., Centralia, Ill.
McCorkendale, Sherman, Tex.
Olmstead, G. G., Knoxville, Tenn.
Pullen, J. T., Ottawa, Ill.
Runner, R. K., Dekalb, Ill.

Reger, W. S., St. Louis, Mo.
Ritchey, L. J., St. Louis, Mo.
Rettew, J. H., Selma, Ala.
Sullivan, R. O., Leadville, Col.
Stannard, C. M., Denver, Col.
Schott, W.H., Bloomington, Ind.
Steinwedell, Geo., Denver, Col.
Schenck, Rudolph, Chicago, Ill.
Scott, H. C., St. Louis, Mo.
Tucker, C. A., St. Louis, Mo.
van Maur, J. D., St. Louis, Mo.
Vance, S. M., Bristol, Tenn.
Van Ness, E. G., St. Louis, Mo.
Whithed, Boulder, Conn.
Whitfield, Al., Chicago, Ill.
White, W. F.
Whitton, St. Louis, Mo.
Whitcomb, H. D., Jr., Jersey City, N. J.
Watt, Robt., Denver, Col.
Wakeman, A. E., Glens Falls, N. Y.

Associate.

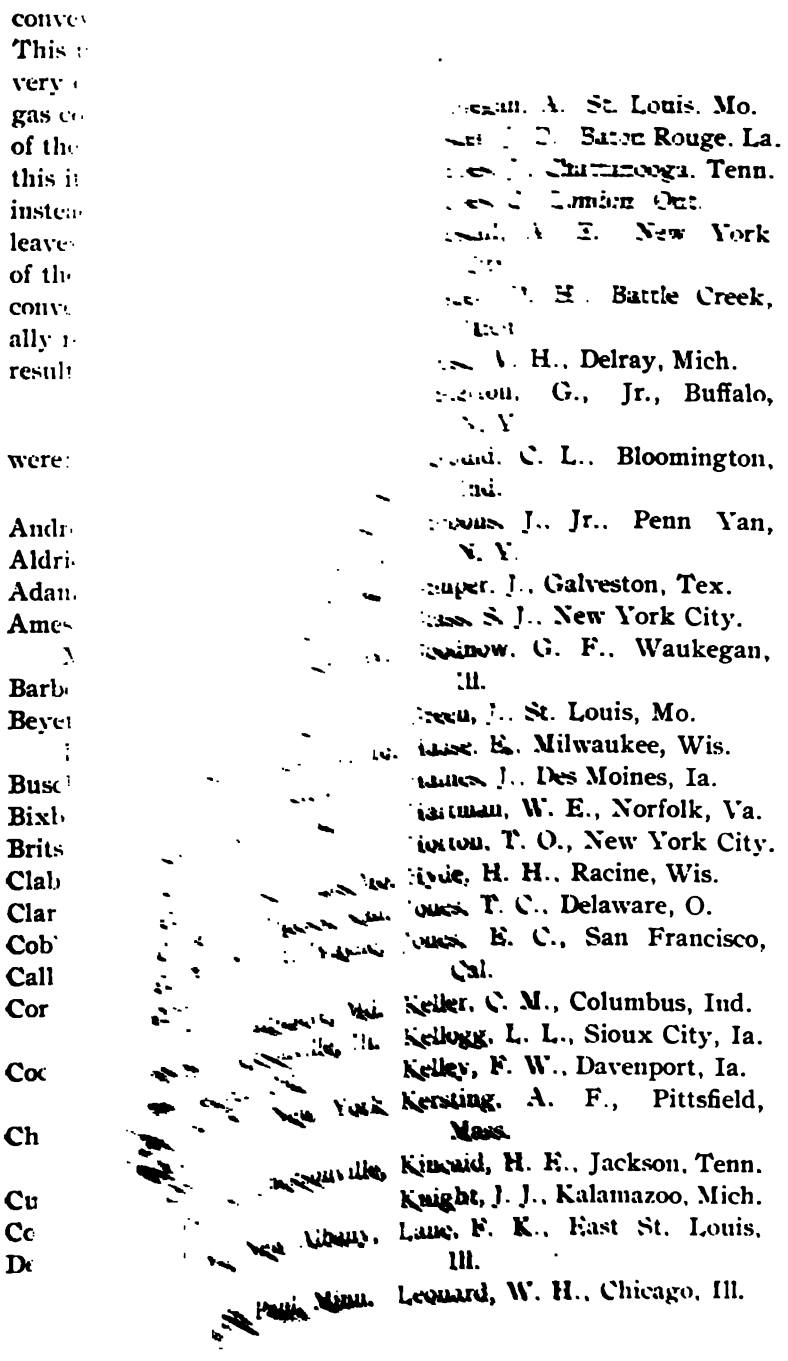
Burgess, W. L., Omaha, Neb.
Bingham, R. W., Philadelphia, Pa.
Brill, A. P., Pittsburg, Pa.
Bigelow, L. S., New York City.
Brewer, R. B., St. Louis, Mo.
Bartless, F. V., Detroit, Mich.
Collins, W., College Point, N. Y.
Dean, M., New York City.
Eisner, J. M., Chicago, Ill.
Goodhue, A. E.
Hicks, G. C., Jr., Connersville, Ind.
Heffern, C. F., New York City.
Holmes, F., Milwaukee, Wis.
Hopton, L. R., New York City.
Leavenwort, M., St. Louis, Mo.
Lotz, Alfred, Chicago, Ill.
Martin, W. W., St. Louis, Mo.
McDonald, A., Erie, Pa.
Miller, F. A., Bradford, Pa.
Osborne, H. H., Detroit, Mich.
Reynolds, M. G., Anderson, Ind.
Stadelman, W. A., New York, City.
Wickham, E. F., St. Louis, Mo.
Whittmore, C. L., St. Louis, Mo.
Wilkins, J. T., Connersville, Ind.

ROLL CALL.

was answered by the following:

Honorary Members.

Barker, F. E., Boston, Mass.
Howard, J. B., Galena, Ill.
Nettleton, C. H., Derby, Conn.
White, W. H., New York City.



Keller, C. M., Columbus, Ind.
Kellogg, L. L., Sioux City, Ia.
Kelley, F. W., Davenport, Ia.
Kersting, A. F., Pittsfield, Mass.
Kincaid, H. E., Jackson, Tenn.
Knight, J. J., Kalamazoo, Mich.
Lane, F. K., East St. Louis, Ill.
Leonard, W. H., Chicago, Ill.

Light, G., Dayton, O.
Lorenz, J., Jackson, Miss.
Lynn, J. R., Waterloo, Ia.
Lynn, J. T., Detroit, Mich.
Macbeth, A. B., Kansas City, Mo.
Mansur, J. H., Royersford, Pa.
McDonald, W., Albany, N. Y.
McIlhenny, J. D., Philadelphia, Pa.
Miller, T. D., New Orleans, La.
Miller, A. S., Baltimore, Md.
Mockett, W. E., Dallas, Tex.
Morrell, E. E., Oak Park, Ill.
Murdock, J. W., Joliet, Ill.
Norris, R., Philadelphia, Pa.
Olds, H. L., Lincoln, Ill.
O'Malley, P., Aurora, Ill.
Perkins, B. W., South Bend, Ind.
Pratt, E. G., Milwaukee, Wis.
Purcell, T. V., Chicago, Ill.
Quinn, A. K., Newport, R. I.
Ramsdell, G. G., New York City.
Roper, G. D., Rockford, Ill.
Runner, Z. T. F., Freeport, Ill.
Searle, R. M., Mt. Vernon, N. Y.
Shattuck, J. D., Chester, Pa.
Shelton, F. H., Philadelphia, Pa.
Slater, A. B., Jr., Fort Wayne, Ind.
Spinning, W. V., Peru, Ind.
Stacey, J. E., Cincinnati, O.
Steinwedell, W., Quincy, Ill.
Steinwedell, W. E., Cleveland, Ohio.
Stephens, H. H., Brookfield, Mo.
Strohn, R. N., La Grange, Ill.
Stiles, A. K., Streator, Ill.
Swann, H. R., Louisville, Ky.
Sweetmann, M. M., Kansas City, Mo.
Tayler, G. H., Warren, O.
Tippy, B. O., Detroit, Mich.
Thwing, O. O., St. Louis, Mo.
Travis, F. M., New Haven, Conn.
Walsh, J. T., Chicago, Ill.
Waring, G. H., Omaha, Neb.
Warmington, D. R., Cleveland, Ohio.
Young, J., Allegheny, Pa.
Young, R., Pittsburg, Pa.

Associate.

Ambler, T. M., St. Louis, Mo.
Buckley, J. C., Chicago, Ill.
Carpenter, H. A., Pittsburg, Pa.
Claybourne, C. W., Chicago, Ill.
Collins, D. J., Philadelphia, Pa.
Eaton, A. B., Chicago, Ill.
Elliott, H. J., Chicago, Ill.
Gilman, G. P., Jr., Chicago, Ill.
Guldlin, O. N., Fort Wayne, Ind.
Harper, H. D., Chicago, Ill.
Hayward, S. F., New York City.
Helme, W. E., Philadelphia, Pa.
Humphrey, A. H., Kalamazoo, Mich.
Jacobs, C. H., Detroit, Mich.

Johnston, E. D., Connersville, Ind.
Kahn, L., Hamilton, O.
Lea, H. I., Fort Wayne, Ind.
Lindsay, C. R., Jr., Chicago, Ill.
Marquis, P. S., St. Louis, Mo.
McDonald, D., Albany, N. Y.
McIlhenny, J., Philadelphia, Pa.
Morava, W., Chicago, Ill.
Mordue, T. N., Chicago, Ill.
Mueller, R., Decatur, Ill.
Osius, G., Detroit, Mich.
Parker, G. W., New York City.
Patton, W. H., Chicago, Ill.
Persons, F. R., Toledo, O.
Reilly, J. A., Cincinnati, O.
Russell, D. R., St. Louis, Mo.
Schall, H. D., Chicago, Ill.
Shirra, J. C., Milwaukee, Wis.
Stacey, A. J., Cincinnati, O.
Stratton, S. S., Chicago, Ill.
Terhune, C. F., New York City.
Van Wie, E. G., Detroit, Mich.
Weber, O. B., New York City.
Wickham, L., St. Louis, Mo.
Witherden, G. M., Philadelphia, Pa.

On motion the Convention was declared adjourned.

PROCEEDINGS

—OF THE—

WESTERN GAS ASSOCIATION

TWENTY-EIGHTH ANNUAL MEETING

—HELD AT—

CHICAGO, ILL.

May 17, 18, 19, 1905.

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OFFICERS

OF THE

WESTERN GAS ASSOCIATION

1904-1905

President.

O. O. THWING.....St. Louis, Mo.

First Vice President.

PAUL DOTY.....St. Paul, Minn.

Second Vice President.

K. M. MITCHELL.....St. Joseph, Mo.

Secretary-Treasurer.

JAMES W. DUNBAR.....New Albany, Ind.

Editor Wrinkle Department.

W. A. BAEHR.....St. Louis, Mo.

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WM. MCDONALD.....	Albany, N. Y.	" "	1905
HENRY L. DOHERTY	Denver, Col.	" "	1905
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PROCEEDINGS

— OF THE —

WESTERN GAS ASSOCIATION.

TWENTY-EIGHTH ANNUAL MEETING

— HELD AT —

AUDITORIUM HOTEL, CHICAGO, ILL.

May 17, 18, 19, 1905.

FIRST DAY—MORNING SESSION.

The President, Mr. O. O. Thwing (St. Louis, Mo.), called the meeting to order, at 10:15 A. M., Wednesday, May 17th. The Secretary's desk was in charge of Mr. James W. Dunbar, of New Albany, Ind. The President introduced Mr. H. S. Taylor, City Prosecuting Attorney for Chicago, who, speaking in behalf of Mayor Dunne, made the following

WELCOMING ADDRESS

Mr. Chairman, Gentlemen of the Western Association of Gas Engineers: Until this morning it was the confident expectation of his Honor, Mayor Dunne, that he would be present himself at this hour and perform in person the pleasant function that has fallen to me. When I arrived at the City Hall, however, this morning, I was summoned to the Mayor's office and he asked me to be his representative on this occasion. He charged me to extend to you his respectful salutations and to express to you a welcome upon his behalf and upon behalf of the city of Chicago upon the occasion of this gathering. He charged me to say that nothing but a pressing and imperative duty would have been permitted to interfere with what would have been to him a pleasant office as well as a duty. He also asked me to assure you, gentlemen, that you may meet and conduct your meetings

[illegible]

[illegible] with conviction that what you will have to say to each other in the discussion of your business will be far more instructive and entertaining than anything I can offer in these unstudied words, I will abruptly conclude by saying that the Mayor represents the city of Chicago in according to this good looking and intelligent looking Association its proper measure of consideration and respect. Gentlemen, you are most heartily welcome to the city of Chicago. (Applause.)

The President introduced Mr. I. C. Copley, of Aurora, Ill., who delivered the following

RESPONSE TO MR. TAYLOR'S WELCOMING WORDS:

Mr. President, Mr. Taylor and Gentlemen of the Western Gas Association: We are deeply sensible of the claims upon the honored Mayor's time, and we thank his representative very much for the cordial welcome extended to us in his behalf. We know more or less of the city of Chicago. We also know more or less of the Mayor, and through him his official regime. In the strenuous campaign which has so happily ended by placing him in his present exalted position, if there has been any shortcomings in his character we should certainly have heard of them. We want you to know us. We are representing practically the entire country. We are engaged in serving the public in our monotonous way, possibly obscure way, just as your honored chief is in his distinguished way. We hope to meet you and him in the same spirit of simplicity, candor and straightforwardness. We are here to improve ourselves, and by improving ourselves we hope to improve the quality of our service to the public.

We know very well the chances that we took in coming to Chicago. We know the chance of the hold-up man. Most of us have been in Chicago more than once and have met him in all his different disguises. We know the chance we take from your scorching automobile drivers. We know the chance we take that one of your sky-scrapers might collapse at an inopportune moment. We know the chance that we take in a mix-up with your strikers, and possibly a mix-up with your strike-breakers, and we also know the chance that we take from an explosion on the Lake front. I regret to say it is possible the New York contingent is not as numerous as it might have been, had they not feared that the articles which their newspapers have been publishing about the state of affairs in Chicago were true. On the other hand our President will assure you, or could assure you, if he would frankly unbosom himself, we probably have a larger delegation here from St. Louis, because they fear that it is not true. I wish, Mr. Taylor, you would take a message from this Association to your honored chief, Mayor Dunne. I first want to introduce to you one of the sages of this Association, "Uncle" Jerry Howard. "Uncle" Jerry, please stand up.

He is the gentleman with the white beard, who has spent a lifetime in the gas business. He is an honorary member of this

Association. He, too, comes from Glasgow, although he is as Scotch as Scotch whiskey itself. Now, in the event your chief should see an opportunity to widen his plans of municipal ownership, we all from experience of the last 82 or 83 years have reason to believe that Uncle Jerry will still be with us. We will save him the expense account of the trip of an expert from Glasgow, and if he will pardon any of the youthful indiscretions or errors of "Uncle" Jerry during this time this Western Gas Association will loan "Uncle" Jerry to his honor. (Laughter and applause.) Necessarily we are watching your experiment here as worked by Mayor Dunne, with a great deal of interest, and whatever may be the outcome, whether he prosecutes that to a successful conclusion or not, those of us who know Mayor Dunne are more than satisfied that he brings to the task, stupendous as we believe it to be, unusual qualities of mind and character. We thank you very much.

APPOINTING SOME SPECIAL COMMITTEES.

The President announced the appointment of the following special committees:

Place of Next Meeting.—Messrs. A. H. Barret, George Clark and Wm. McDonald.

Introduction of Visitors.—Mr. J. B. Howard.

Final Resolutions.—Messrs. K. M. Mitchell, George McLean and Irvin Butterworth.

Vice-President Doty assumed the Chair, and the President read his

INAUGURAL ADDRESS.

In addressing you, gentlemen, who have so highly honored me by selecting me to preside over your deliberations at this time, I have in mind that our programme is a long and interesting one and that no time should be wasted by mere prolixity or verbiage. I will therefore be as brief as possible in my remarks.

Consolidation of Gas Associations.—At the Convention of the Congress of Gas Associations of America, in St. Louis, June, 1904, a plan was adopted for the formation of a committee to formulate a scheme for "A Single Gas Association Composed of the Men Engaged in the Gas Industry in North America." This

committee was to be composed of two representatives from each of the Associations then in existence and of three delegates at large. The committee was duly appointed and has met. I am not aware that any report has been made by this committee up to the present time, but trust that the representatives from this Association will be prepared to report during the present meeting.

The tendency of the times is toward consolidation, or rather combination and organization of allied interests, and there is no doubt that, if a satisfactory plan can be evolved, much benefit would be derived from an organization of our gas associations under one directing board or committee. By means of such an organization, matters of large importance and questions of much complexity could be taken up by the head organization, whether called "Board," "Committee" or "Association," and followed to an intelligent and definite conclusion, leaving the practical and local questions to the consideration of the individual associations. There is no question that sustained and continued study of problems of importance has not been the practice in any of our Associations, but that members have been encouraged to write "as the spirit moved them," and generally upon any subject that they cared to select. In consequence, cumulative research has not been the rule, except where an individual member has been sufficiently interested to undertake it. A general supervision by a competent board of the work of all of our gas associations would certainly be beneficial both to them and to the fraternity at large but to overthrow and annihilate the older associations and substitute in their places a single new one, is, in my opinion extremely unwise and undesirable. For our gas associations are more than mere vehicles for formal discussion and investigation of topics of interest presented to them as societies. Their annual meetings are opportunities for reunions of old friendships and the beginning of new ones, among as broad-minded and capable a lot of men as ever associated together in the same line of business. I regard the personal interchange of thought, experience and opinion, which do not appear in the printed proceedings, as being of more value to the members individually than any part of the printed programme. There the young and inexperienced superintendent, who is puzzled over some course of procedure or worried over some condition, will meet those who are competent

to advise him, and who will cheerfully do so; there the older and experienced man replenishes his fund of knowledge and learning from that of the enthusiastic younger one, fresh from the schools, and full of new methods, theories and discoveries. This feeling of fraternity and fellowship, of mutual esteem and willingness to assist, is especially noticeable in the Western Gas Association, and let us hope that it will remain a feature of the Association forever.

In looking over the records of the Western Gas Association I find, among the proceedings of 1887, a paper prepared by Mr. Frederick Egner, on "An American Gas Institute." The discussion following this paper reveals the fact that, for several years previous to 1887, both the American and the Western Associations had been endeavoring to form an association or board representing all the gas associations and all the gas companies in the country, and supported in much the same manner as the proposed "Single Gas Association" is to be supported by the scheme of organization submitted at the Gas Congress. The objects of the Association, Board, Institute, or what you will, were practically the same as those given as a reason for the consolidation of gas associations, namely: For mutual aid against unfair competition and unjust legislation; to gather and disseminate general information regarding matters concerning or relating to the industry; to more especially exert a watchful eye over the field of invention; to investigate, and, if possible, try all alleged improvements, reporting freely on their value, and to carry on general research and investigation for the benefit of the gas industry. It seems that all efforts to accomplish any undertaking of this kind died of inanition, due to the indifference of those who were expected to aid the plan financially, and the committee appointed to again take up the plan, as advocated by Mr. Egner in his paper, was compelled to report failure at the next meeting of this Association for the same reason.

In view of the doubtful prospects of the formation of a single gas association in the near future from those now in existence, I would recommend that the Western Association again take up the consideration of a Gas Institute, and, having shown during the past year that it was capable of carrying on, alone, a gas exhibit at a World's Fair, in spite of former failures, I have no doubt that something tangible is bound to result. There is no

reason why the preliminary work on a project of this kind should not be undertaken by one body, put into definite shape as far as possible, and then submitted to the other associations for criticism, amendment and finally co-operation.

We Have Received a Proposal.—At the last meeting of the Ohio Gas Light Association it was decided by resolution to defer the location and time of the next meeting of that Association, pending a proposition to the Western Gas Association for the holding of a joint convention in May, 1906, with the object in view of a permanent consolidation of the two Associations. It is certainly flattering for a rather sedate and elderly maiden of 28 to be wooed by such a young and lusty lover; but would it be wise for her to encourage him in his attentions?

In the first place, it is generally understood that, while the young man has many good qualities and considerable ability, he is inclined to be rather wild and reckless and has grown to look down upon the old home where he was born and raised. He is of a roving disposition, having been seen in Pittsburg this year when he should have been at home attending to his duties. It has also been whispered about that lately he has been living beyond his means and is hardly in the position financially to assume the burden of matrimony.

However, this proposition from the Ohio Association is one of grave importance to the two Associations, and when it is presented before this meeting I hope that we will have a full attendance and that no hasty action will be taken in the matter. If there is any prospect of action on the proposed organization of American Associations in the near future, I cannot see any reason for previous consolidation of any two or more existing Associations pending such action. It would be best for them to preserve their integrity as distinct associations in order that their individual influence may be felt when the scheme of consolidation is reported.

Municipal Ownership.—I wish for a moment to call your attention to the present agitation of the question of municipal ownership. Hardly a daily paper or magazine can be read without finding some article exploiting the subject. Glasgow is sending her missionaries to this country in large numbers, if reports are to be believed, and they are assiduously spreading her gospel. The literature of our Associations has covered this field

thoroughly and well, but that literature is not read by the public. I believe that this subject is serious enough at the present time to justify the appointment of a special committee to investigate the best methods of presenting the gas companies' side of this question and the protection of their interests. The formation of State Gas Commissions, to be composed of men of intelligence and integrity, can well be considered in this connection.

Western Association at the World's Fair.—At the Louisiana Purchase Exposition, held in St. Louis, in 1904, the gas industry through the efforts of the Western Gas Association and its members, received official recognition for the first time at any International Exhibition. In the name of the Western Gas Association, one of the most complete and attractive exhibits in the Liberal Arts Building was installed by Mr. F. H. Shelton, our then President, and personally supervised, during the Exposition period, by Mr. F. R. Persons. These gentlemen contributed freely of their time and brains to the success of this undertaking, and its unqualified success, now a matter of history, is an honor to both of them and to this Association. A report and history of this exhibit will be presented for your consideration and will prove most interesting.

London Exhibits of Coal Tar Products.—Near the booth of the Western Gas Association, in the British section of the Department of Chemical and Pharmaceutical Arts, were located two exhibits that attracted deserved and admiring attention from the visiting gas men. One was by the London Gas Light and Coke Company and the other by the South Metropolitan Company, also of London. Among the products exhibited, I will mention the following as showing the extent of the industry and the completeness of the exhibit. The samples were furnished by the Gas Light and Coke Company's Tar and Ammonia Products Works, at Beckton:

Refined tar, anthraquinone, picric acid, sulphur, toluol, benzol, naphtha, aniline salts, alizarine, pyridine, crude bases, anthracene (40, 80 and 90 per cent.) naphthalene in candles, balls, flakes, powder, rice, rock and tablets; dinitro-benzol, nitronaphthalene; anhydrous ammonia and ammonia, sp. gr. .880; ammonia chlorides; carbonate, ferry-cyanide, nitrite and sulphite; creosotes; green oil, anthracene oil, sharp oil, crude light oil,

carbolic acids; potassium and sodium cyanide and prussiates; Prussian blue, etc.

We are all aware that the market for gas works residuals, particularly tar, is steadily weakening. The greatly increased production, due to the recovery of tar from the manufacture of coke, has demoralized prices and as a last resort many producers are compelled to use their tar for fuel. In this country of cheap coal, tar is too valuable a product to be used as fuel. Why should we continue to reduce our tar only to such products as pitch, crude creosote, light oils and occasionally naphthalene, while practically all the more valuable products are imported into this country? Why should we not follow the same course of ultimate refinement and preparation of our residuals for special markets, as these companies do, instead of depending upon a general market for our crude products?

Papers.—A glance at our paper list shows a goodly number of contributions covering a wide field of interesting subjects. "Cement Joints," by Mr. J. D. von Maur, is a history of experiment that points its own moral. "Use of Tar as Fuel in Bench Firing," by Mr. F. C. Sherman, tells us the way to do something that we hope not to be obliged to do very long. The "Wrinkle Department," edited by Mr. W. A. Baehr, is as ample and up-to-date as the editor himself. Mr. Irvin Butterworth has discovered a way to "Prevent Stoppages in Service, Meters and House Pipes in Cold Weather," and we are all glad that he is to tell us about it. "Acetylene," that former bogey of the gas man, will be treated of by Mr. J. M. Morehead, who was its original captor. Mr. B. E. Chollar will furnish us with a philosophical discourse on "The Evolution of the Engineer." Mr. K. M. Mitchell and Mr. T. D. Miller will occupy the arena exploiting the respective merits of "Kansas Oil" and "Texas Oil." "The Practical Enrichment of Low Candle Power Coal Gas with Benzol" will be presented by Mr. F. B. Wheeler, who makes both and ought to know. Mr. W. B. Calkins will tell us how "Coal Sampling and Testing" should be done. "The Ideal Corporation" has been evolved by Mr. N. D. Cochran, and we will learn whether he wishes to promote it or not at this meeting. "The Rotary Blower and Exhauster: Its Construction, Efficiency and Application," explained by Mr. George C. Hicks, Jr., will inform us about a subject on which we have hitherto had

little literature. Mr. O. N. Guldlin, who did yeoman's service in securing classifications for our industry at the Fair, will relate his "Experience as an Exhibitor at the World's Fair."

Necrology.—Death has laid a heavy hand upon our Association during the past year and has taken from us some of our best loved and most able members:

A. B. Slater, Providence, R. I.,	Died June 26, 1904.
William Henry White, New York City,	" July 3, 1904.
Chas. W. Blodget, New York City	" Aug. 2, 1904.
Oscar B. Weber, New York City,	" Sept. 16, 1904.
Chas. E. Hess, Jackson City, Mo.,	" Dec. 22, 1904.
James Somerville, Indianapolis, Ind.,	" Feb. 13, 1905.

A little later we will lay aside our business for a time and join in paying tribute to the memory of these friends of ours who are no longer here.

Gentlemen, the Twenty-eighth Annual Meeting of the Western Gas Association is now in your hands.

COMMITTEE ON PRESIDENT'S ADDRESS.

On motion, the address was ordered referred to a committee of three for consideration and report, and Vice-President Doty appointed as such committee Messrs. E. G. Pratt, Alfred E. Forstall and W. E. Steinwedell.

The President resumed the Chair and said, no objection offering, the reading of the minutes would be deferred. He then called for the

REPORT OF THE BOARD OF DIRECTORS.

which was read by the Secretary as follows:

CHICAGO, ILL., May 16th, 1905.

The annual meeting of the Board of Directors of the Western Gas Association was held in the Auditorium Hotel at 10 A. M., with the President, Mr. O. O. Thwing, of St. Louis, in the Chair. The following members were in attendance: Paul Doty, First Vice-President, St. Paul, Minn.; K. M. Mitchell, Second Vice-President, St. Joseph, Mo.; Wm. McDonald, Albany, N. Y.; J. D. McIlhenny, Philadelphia, Pa.; W. A. Baehr, St. Louis, Mo.; Thomas D. Miller, New Orleans, La.; James W. Dunbar, New Albany, Ind.

On motion, the following papers were recommended for presentation to the Association:

"Cement Joints," by Jacob D. von Maur, St. Louis, Mo.

"Use of Tar as Fuel in Bench Firing," by Mr. F. C. Sherman, New Haven, Conn.

"The Prevention of Stoppages in Services, Meters and House Pipes in Cold Weather," by Mr. Irvin Butterworth, Grand Rapids, Mich.

"Wrinkle Department," edited by Mr. W. A. Baehr, St. Louis, Mo.

"Kansas Oil," by Mr. K. M. Mitchell, St. Joseph, Mo.

"Calcium Carbide and Acetylene," by Mr. J. M. Morehead, Chicago.

"Coal Sampling and Testing," by Mr. W. B. Calkins, Fairmount, Va.

"The Practical Enrichment of Low Candle Power Coal Gas with Benzol: Its Convenience and Advantages," by Mr. F. B. Wheeler, Detroit, Mich.

"Texas Oil Fields," by Mr. Thos. D. Miller, New Orleans, La.

"The Rotary Blower and Exhauster: Its Construction, Efficiency and Application," by Mr. George C. Hicks, Jr., Connersville, Ind.

"The Evolution of the Gas Engineer," by Mr. B. E. Chollar, Kansas City, Mo.

The paper by Mr. N. D. Cochran, not having been received, was referred to the Executive Committee.

On motion of Mr. Dunbar it was voted that the Board of Directors recommend the appropriation of $500 to the Gas Educational Fund of the American Gas Light Association, the same to be paid in $100 annual installments.

The Secretary-Treasurer submitted his annual report, which as Treasurer showed a receipt for the year of $2,596.40, an expenditure of $2,874.04, and a balance of $718.46. As Secretary the report showed a total membership of 472—both reports being rendered to May 1, 1905.

The President appointed the following committees:

Auditing.—Messrs. Wm. A. Baehr, K. M. Mitchell, Thos. D. Miller.

New Members.—Wm. McDonald, K. M. Mitchell, John D. McIlhenny.

Memorials.—John McIlhenny, Wm. McDonald, John Gribbell, F. H. Shelton.

10 A. M. and 2 P. M. were selected as the hours for convening the sessions. No further business offering, the Board adjourned.

On motion of Mr. E. G. Pratt (seconded) the report was received and ordered spread upon the minutes.

THE SECRETARY—Does that include the recommendation contained therein, in reference to the appropriation of $500 to the educational fund?

MR. PRATT—Yes, sir.

The President said that a local photographer wished to make a flash-light photograph of the assembly at the close of the session in the afternoon, and that anyone who wished to be photographed should be present at that time.

ROLL CALL AND MEMBERS PRESENT.

Honorary.

Howard, J. B., Galena, Ill.

Active.

Ames, Knowlton L., Evanston, Ill.
Baehr, Wm. A., St. Louis, Mo.
Barret, A. H., Louisville, Ky.
Battin, Wm. I., Chicago, Ill.
Beardslee, C. S., Cleveland, O.
Bedard, F. W., LaSalle, Ill.
Berkley, J. M., Bloomington, Ill.
Bixby, H., Quincy, Ill.
Bixby, W. A., Quincy, Ill.
Blinks, W. M., Kalamazoo, Mich.
Bowers, W. L., Davenport, Ia.
Bradley, C. W., Chicago, Ill.
Bredel, F., Milwaukee, Wis.
Brown, R. B., Milwaukee, Wis.
Butterworth, Irvin, Grand Rapids, Mich.
Clabaugh, G. W., Omaha, Neb.
Clark, J. C. D., St. Louis, Mo.
Clarke, G. S., Kansas City, Mo.
Clapp, G. N., Middletown, O.
Clary, E. D., Burlington, Ia.
Collins, C., Elkhart, Ind.
Cornish, R. C., Milwaukee, Wis.
Copley, I. C., Aurora, Ill.
Cowdery, E. G., St. Louis, Mo.
Cowdery, R. E., Topeka, Kas.
Cressler, A. D., Ft. Wayne, Ind.
Dawes, R. C., Chicago, Ill.
Day, C. L., Chicago, Ill.
Dell, J., St. Louis, Mo.
Dickey, C. H., Baltimore, Md.
Doty, Paul, St. Paul, Minn.
Douglas, H. W., Ann Arbor, Mich.
Duffield, J. C., Ontario, Can.
Dunbar, J. W., New Albany, Ind.

Elbert, V. L., St. Paul, Minn.
Egman, L. E., Pueblo, Col.
Eustace, J. H., Chicago, Ill.
Eustace, E. W., Peoria, Ill.
Evans, Chas. H., Chicago, Ill.
Ferrier, James, Rome, Ga.
Finnegan, A., Granite City, Ill.
Fitch, H. D., Bowling Green, Ky.
Fitz, R. F., Elgin, Ill.
Fitzgerald, L., Waukegan, Ill.
Forstall, A. E., New York City.
Frazer, D. H., Battle Creek, Mich.
Freese, F. W., Fort Wayne, Ind.
Fullerton, G., Jr., Schenectady, N. Y.
Gerould, C. L., Bloomington, Ind.
Gimper, E. H., New Orleans, La.
Glass, S. J., New York City.
Goodnow, G. F., Waukegan, Ill.
Gribbel, J, Philadelphia, Pa.
Hanies, J., Des Moines, Ia.
Hartman, Wm. E., Joliet, Ill.
Holman, C. L., St. Louis, Mo.
Hood, J. E., Knoxville, Tenn.
Howard, C. A., Aberdeen, S. D.
Hyde, H. H., Racine, Wis.
Jones, T. C., Delaware, O.
Kellogg, L. L., Sioux City, Ia.
Kelley, F. W., Davenport, Ia.
Kersting, A. F., Hammond, Ind.
Kincaid, H. E., Jackson, Tenn.
King, J. H., Chicago, Ill.
Kraft, R. P., Milwaukee, Wis.
Lathrop, A. P., Detroit, Mich.
Leonard, W. H., Chicago, Ill.
Lloyd, E. F., Detroit, Mich.
Luther, F. E., Chicago, Ill.
Lynn, J. R., Portsmouth, O.
Lynn, J. T., Detroit, Mich.
Mansur, J. H., Royesford, Pa.
Maxon, J. H., Columbus, S. C.
McAdams, Bryce, Milwaukee, Wis.
McClary, N. A., Chicago, Ill.
McDonald, D., Louisville, Ky.
McDonald, Wm., Albany N. Y.
McIlhenny, J. D., Philadelphia, Pa.
McCorkindale, W. J., Sherman, Tex.
McLean, Geo., Dubuque, Ia.
Meeker C. A., Muncie, Ind.
Miller, T. D., New Orleans, La.
Miller, W. A., Cincinnati, O.
Mitchell, K. M., St. Joseph, Mo.
Morrell, E. E., Chicago, Ill.
Morgans, W. H., Pontiac, Mich.
Morton, H. E., Boone, Ia.
Moses, F. D., Trenton, N. J.
Murdock, G. T., Elkhart, Ind.
Murdock, J. W., Joliet, Ill.
Murphy, C. A., Oswego, N. Y.
Norris Rollin, Philadelphia, Pa.
Olds, H. L., Lincoln, Ill.
O'Malley P., Aurora, Ill.
Perkins, B. W., South Bend Ind.
Pratt, E. G., Milwaukee, Wis.
Purcell, T. V., Chicago, Ill.
Putnam, W. R., Red Wing, Minn.
Quinn, A. K., Newport, R. I.
Ramsdell, G. G., New York City.
Rew, Irwin, Chicago, Ill.

Roper, G. D., Rockford, Ill.
Runner, R. K., DeKalb, Ill.
Runner, Z. T. F., Freeport, Ill.
Schott, W. H., Chicago, Ill.
Strohn, R. N., Aurora, Ill.
Slater, A. B., Fort Wayne, Ind.
Steinwedell, Wm., Quincy, Ill.
Steinwedell, W. E., Cleveland, Ohio.
Stephens, H. H., Brookfield, Mo.
Stiles, A. K., Streator, Ill.
Sullivan, R. B., Denver, Col.
Summers, Geo., Chicago, Ill.
Sweetman, M. M., Kansas City, Mo.
Taylor, G. H., Warren, O.
Thwing, O. O., St. Louis, Mo.
Travis, F. M., Torrington, Conn.
von Maur, J. D., St. Louis, Mo.
Wallace, Wm., Lafayette, Ind.
Walters, B. S., Chicago, Ill.
Waring, G. H., Omaha, Neb.
Warnking, Geo., Berlin, Wis.
Wheeler, F. B., Detroit, Mich.
Whipple, H. S., Rockford, Ill.
Whitton, W. H., St. Louis, Mo.
Williamson, John, Chicago, Ill.

Associate.

Barnes, G. W., Pittsburg, Pa.
Bigelow, L. S., New York City.
Bingham, R. W., Chicago, Ill.
Brill, A. P., Pittsburg, Pa.,
Brownell, E. E., Chicago, Ill.
Burgess, W. L., Omaha, Neb.
Callenbach, Dr. J. A., Camden, N. J.
Clark, G. M., Chicago, Ill.
Claybourne, C. W., Chicago, Ill.
Corbus, F. G., Philadelphia, Pa.
Eaton, A. B., Chicago, Ill.
Elliott, H. J., Chicago, Ill.
Gassett, A. L., Cleveland, O.
Guldlin, O. N., Fort Wayne, Ind.
Harper. H. D., Chicago, Ill.
Hayward, S. F., New York City.
Heffern, C. S., St. Louis, Mo.
Helme, Wm. E., Philadelphia, Pa.
Henry, W. G., Chicago, Ill.
Hicks, G. C., Jr., Connorsville, Ind.
Humphrey, A. H., Kalamazoo, Mich.
Jacobs, C. H., Detroit, Mich.
Kahn, L., Hamilton, O.
Kellum, B. J., Chicago, Ill.
Leakey, N. G., Detroit, Mich.
Lindsay, C. R. J., Chicago, Ill.
MacDonald, Albert, Erie, Pa.
McDonald, D., Albany, N. Y.
McIlhenny, J., Philadelphia, Pa.
Miller, F. A., Bradford, Pa.
Morava, W., Chicago, Ill.
Mordue, T. N., Chicago, Ill.
Mueller, R., Decatur, Ill.
Olmsted, G. G., Chicago, Ill.
Osborn, H. H., Chicago, Ill.
Persons, F. R., Toledo, O.

Reilly, J. A., Cincinnati, O.
Reynolds, M. G., Anderson, Ind.
Russell, D. R., St. Louis, Mo.
Shirra, J. C., Milwaukee, Wis.
Stratton, S. S., Chicago, Ill.
Terhune, C. F., New York City.
Wickham, L., St. Louis, Mo.
Wickham, E. P., St. Louis, Mo.
Witherden, G. M., Philadelphia, Pa.

REPORT OF COMMITTEE ON APPLICATION FOR MEMBERSHIP.

MR. WM. MCDONALD—The following gentlemen have been proposed for membership in the Association.

Active.

Averill, A. T., Cedar Rapids, Ia.
Atwater, C. G., New York City.
Allen, Wm. H., Newark, N. J.
Abell, W. A., Taylorville, Ill.
Berry, F. K., St. Paul, Minn.
Baer, H. S., Hancock, Mich.
Burgess, C. F., Madison, Wis.
Barger, E. T., Detroit, Mich.
Beach, E. C., Chicago Heights, Ill.
Cronin, E. A., Kansas City, Mo.
Collins, H. P., Little Falls, N. Y.
Connors, M., Chicago, Ill.
Chichester, A. A., Chicago, Ill.
Crawford, H. T., Waukegan, Ill.
Chamberlain, G. R., Grand Rapids, Mich.
Crowell, F. B., Atlanta, Ga.
Crighton, D. K., Oak Park, Ill.
Duncan, F. C., Galesburg, Ill.
Davis, D., Litchfield, Ill.
Dawson, G. H., La Grange, Ill.
Dibbens, W. J., Chicago, Ill.
Dougherty, B. R., Richmond, Ky.
Earnshaw, E. H., Cincinnati, Ohio.
Ferris, W. J., Monmouth, Ill.
Farr, A. L., Chicago, Ill.
Fogg, O. H., Flushing, N. Y.
Gille, H. J., St. Paul, Minn.
Greim, O. F., Milwaukee, Wis.
Graf, C. H., Indianapolis, Ind.
Gross, A. H., Sterling, Ill.
Gutsche, E. J., St. Paul, Minn.
Humphrey, H. H., Jefferson City, Mo.
Higgins, H. C., Dixon, Ill.
Harrington, A. S., Chicago, Ill.
Hammon, W. H., Pittsburg, Pa.
Hutchinson, W. E., Hudson, Kas.
Johnson, H. B., New Decatur, Ala.
James, F. M., Aurora, Ill.
Jenks, R. J., Evanston, Ill.

Jelliffe, C. N., New York City.
Johnston, J. P., Princeton, Ind.
Levings, W. H., Minneapolis, Minn.
Lane, R. M., Chicago, Ill.
Lane, F. K., Fishkill Landing, N. Y.
McLaughlin, R. A., Galesburg, Ill.
McDonald, W. B., Evansville, Ind.
Milligan, A. L., Detroit, Mich.
Miller, R. L., Muncie, Ind.
Markley, J. C., Chicago, Ill.
Moore, H. M., Austin, Tex.
Morehead, J. M., Chicago, Ill.
Newberry, F. E., Kankakee, Ill.
Osborn, M. C., Butte, Mont.
Parker, J. R., Hancock, Mich.
Pease, A. C., Lowell, Mass.
Price, F. L., Highland Park, Ill.
Patten, J. A., Manitowoc, Wis.
Reese, R., Memphis, Tenn.
Richards, F. M., Madison, Wis.
Rice, H. L., Aurora, Ill.
Rand, A. T., Minneapolis, Minn.
Shepard, F. C., Minneapolis, Minn.
Shattuck, A. F., Detroit, Mich.
Scott, E., LaPorte, Ind.
Stratton, C. J., Chicago, Ill.
Shumway, J. N., Taylorville, Ill.
Sinsel, O. A., Detroit, Mich.
Schwarm, C. A., Detroit, Mich.
Schmidt, E. G., Springfield, Ill.
Shockley, B. J., Albert Lea, Minn.
Steinwedell, C. S., St. Paul, Minn.
Stiles, H. B., St. Paul, Minn.
Strohn, C. B., Aurora, Ill.
Turneaure, F. E., Madison, Wis.
Traver, A. F., Grand Rapids, Mich.
Utley, B. L., Watertown, Wis.
Wilkinson, A. L., Detroit, Mich.
Wolff, S. E., Jackson, Mich.
Wortendyke, I. F., Janesville, Wis.
Wright, E. J. H., Oak Park, Ill.
Young, J. M. H., Joplin, Mo.

Associate.

Asendorph, C., Chicago, Ill.
Buel, T. D., Detroit, Mich.
Brown, C. H., Des Moines, Ia.
Borat, E., Baltimore, Md.
Black, B. A., New York City.
Carney, M. J., Chicago, Ill.
Cruse, A. R., Philadelphia, Pa.
Carter, T. B., St. Louis, Mo.
Collins, H. S., St. Louis, Mo.
Callahan, A. F., Chicago, Ill.
Hulswitt, F. T., Grand Rapids, Mich.
Cressler, G. H., Fort Wayne, Ind.
Douglas, R. C., Chicago, Ill.
Dickey, E. S., Baltimore, Md.
Darling, W. S., North Chicago, Ill.
Fuertado, R. S., Chicago, Ill.
Flinn, C. F., Chicago, Ill.

Flower, W. L., St. Louis, Mo.
Gregory, G. H., New York City.
Green, J. L., St. Louis, Mo.
Healan, R. H., Chicago, Ill.
Hobdell, G., Jr., Philadelphia, Pa.
Horton, A. W., Chicago, Ill.
Jenks, L. B., Chicago, Ill.
Lockwood, W. A., St. Louis, Mo.
Leiter, J., Chicago, Ill.
Lovett, E. C., Oak Park, Ill.
Melcher, C. W., Chicago, Ill.
Moon, O. P., Cleveland, O.
Ordway, L. P., St. Paul, Minn.
Polk, R. W., St. Louis, Mo.
Porter, R. G., Pittsburgh, Pa.
Pratt, H., Chicago, Ill.
Printz, C. H., Fort Wayne, Ind.
Seeger, R., St. Louis, Mo.
Strain, J. R., Chicago, Ill.
Scott, T. J., St. Louis, Mo.
Sherburne, J. M., Chicago, Ill.
Tracy, J. F., St. Louis, Mo.
Ummath, C. E., Chicago, Ill.
Wortham, E. L., Des Moines, Ia.
Whitaker, M. C., New York City.
Woodward, W. B., St. Louis, Mo.
Zitzewitz, H., Chicago, Ill.

ELECTION OF NEW MEMBERS.

THE PRESIDENT—Gentlemen, you have the report of the committee on applications for membership. What is your pleasure?

On motion of Mr. Steinwedell the Secretary was instructed to cast the ballot of the Association in favor of electing to membership the gentlemen recommended by the committee. The Secretary subsequently reported that the instruction had been carried out, and those of the newly elected members present were welcomed to the privileges conferred by Mr. J. B. Howard.

MR. MCDONALD—I learn that there are one or two gentlemen who think their names should have been amongst those just acted upon, and probably ought to have been, but who are not on the list. I want to say to them that there will be another report of the membership committee tomorrow morning, introducing some more members. We will then correct the tabulation.

AN ANNOUNCEMENT BY THE SECRETARY.

THE SECRETARY—As part of the entertainment provided by the local committee, there will be on Friday afternoon a trip through the tunnels that are being constructed in Chicago. These tunnels are considered an engineering feat, and I do not believe that any of the members of the Western Gas Association will want to go away from this city without beholding their

wonders. All work on the tunnel will be stopped during the hours that we make the trip, so that the members of the Association will have full opportunity to view the work that has been and is being done. This trip has been arranged for Friday, at 1:30 or 2 P. M.

The President introduced Mr. Jacob D. von Maur, of St. Louis, Mo., who read the following paper on

CEMENT JOINTS.

Mr. President and Members, Western Gas Association—During the past year the Laclede Gas Light Company received notice from the Director of Public Works, of the city of St. Louis, to discontinue the use of cement joints in the laying of our gas mains throughout the city, on the ground that these joints would undoubtedly leak in the future, which would necessitate the tearing up of the streets in order to repair the same. As there has never been any objection on the part of the city to the use of lead, it can be assumed that the city officials feel that there is a greater chance of leakage in our gas mains where the joints are made with cement than where they are made with lead. In order to convince the city officials that by using cement for joint making the leakage would be lessened rather than increased, and that there would, therefore, be less tearing up of the streets to repair such leaks, it was decided to make a thorough investigation of the whole subject, and to that end information was requested from a large number of gas companies throughout the United States, in order to determine what the experience was in other cities.

A circular letter was, therefore, written to all the leading gas companies, being careful to select such companies so that the answers when compiled and tabulated would represent the average judgment of gas engineers throughout the country. The letter is quoted below in full:

"The city authorities of St. Louis recently requested the Laclede Gas Light Company to discontinue the use of cement in making up the joints of gas mains, claiming that the use of cement for this purpose is unsafe and will result in an abnormal number of leaks, which would necessitate the tearing up of the city streets for the purpose of repairing the same. We, of course, hold quite the opposite view to that held by the city, but in order

to settle the question once for all, and to the satisfaction of all concerned, we should like to get data from such gas companies as are at present using cement in laying gas mains, and to that end we respectfully ask you to answer the following questions:

"1. To what extent are you using cement in the laying of gas mains in your city?

"2. How many years have you been using cement?

"3. Have leaks in gas mains increased or decreased since you started to use cement for the joints instead of lead?

"4. Have any really serious leaks occurred on a cement joint when the work was properly done?

"5. Is there any objection on the part of the city authorities to the use of cement for this purpose?

"6. Do you make any provision for expansion?

"7. In your judgment, assuming that pipes are laid with the minimum cover of 4 feet and joints properly made with cement, do you think the chances for a leak would be increased or decreased over what they would be had the joints been laid with lead?"

"8. What brand of cement do you use?"

"Any information which you desire to impart will be appreciated."

That the importance of the question was appreciated by all is best shown by the number of answers received, there being a total of 52 answers out of a total of 60 requests. With a large number of the answers came a request for a copy of the report when the investigation was completed. Our President, Mr. O. O. Thwing, requested the writer to furnish the information to the gas fraternity in the form of a paper, to be read before this Association.

The answers received are given in full in the appendix; also a summary of all the answers. A careful survey of the answers as received brings out the following points:

1st. You will note that, in general, those answers which are unfavorable to the use of cement come from cities where cement has never been tried very extensively.

2d. There seems to be a prejudice against the use of cement in the business sections of the very large cities.

3d. In a number of cases the cement joint was used to a very limited extent with very good success, yet for some unexplainable reason its use was not continued.

4th. In every case, with one exception, Portland cement was used, and in the exception noted Rosendale cement was used.

5th. There is a difference of opinion as to whether it is necessary to use the foreign or more expensive brands of Portland or domestic cements.

6th. There is a very wide difference of opinion as to whether provision should be made for expansion or not, but in every case where provision was made it all it was done by inserting lead joints at stated intervals.

7th. It seems to be the generally accepted opinion that cement should not be used in soft places or in any place where there is likely to be a settlement of the pipe, or where the pipe is subjected to vibration.

8th. It is very important to note that in almost every case the test applied to pipe laid with cement joints are many times greater than the tests applied to pipes laid with lead joints.

9th. In only one case was an objection made by the city officials to the use of cement joints and this objection was removed as soon as the value of the cement joint was demonstrated; so that at present we have no record of an objection on the part of the city officials to the use of cement in making up joints.

10th. In no case has the leakage increased by the use of cement and in nearly every case the leakage has decreased.

It is now my purpose to discuss each one of the above items, but before doing so I give below full reports of what has been done in St. Louis.

EXPERIENCE IN ST. LOUIS.

I have not been able to determine to what extent cement was used by the old company in St. Louis. At various points where we excavated we found cement joints. On several lines on which cement was used the joints leaked very badly, notably the 16-inch high pressure line leading from Station "A" to Station "C." That these joints were not made properly was evidenced by the fact that in many cases we found the yarn sticking out of the joint, near the bottom of the bell, and I feel sure that whenever a leak has been found the cause was due to a joint being improperly made.

This Company commenced laying its mains with cement last

May and has laid an increasing number of feet, with cement joint, each month since that time, until now all lines are laid with cement. Better than any discussion I could give will be special reports on work actually done. Starting with the size 4-inch—the smallest we lay—I give below in full reports of work done.

First.—A report of test made to determine at what pressure a 4-inch cement joint, properly made, will leak, and to ascertain whether such joints will leak when they are subjected to a settlement of the pipe.

"I beg leave to submit to you the following report on the special test made upon 4 lengths of 4-inch pipe. The joints were 5 in number and the material mixed in the following proportion: Cement, 2 quarts; water, 1⅓ pints.

"These joints were allowed to set for 36 hours and then a trial pressure of 60 pounds was put on, which was gradually increased until we reached the limit of the engine, viz: 125 pounds per square inch. This pressure was allowed to remain for 30 minutes, without any apparent variation in the gauge. The joints were also tested with soapsuds every 5 minutes to see if any leaks could be detected.

"In order to see if a cement joint contained any elasticity, a man was placed in the middle of the line, and after the center blocking was removed, danced up and down on it, causing it to fluctuate from 6 inches to 8 inches each way, and even at this very high pressure and undue strain no leaks were found, neither was the cement disturbed in any manner.

"The blocking was then taken away from the ends and the plug and the cap left free of support, in order to see if the high pressure would move them out of place, but no motion was seen.

"The pressure was then reduced to 15 pounds per square inch. In order to ascertain the amount of give or play a cement joint would allow, we subjected the line to the following harsh test or treatment.

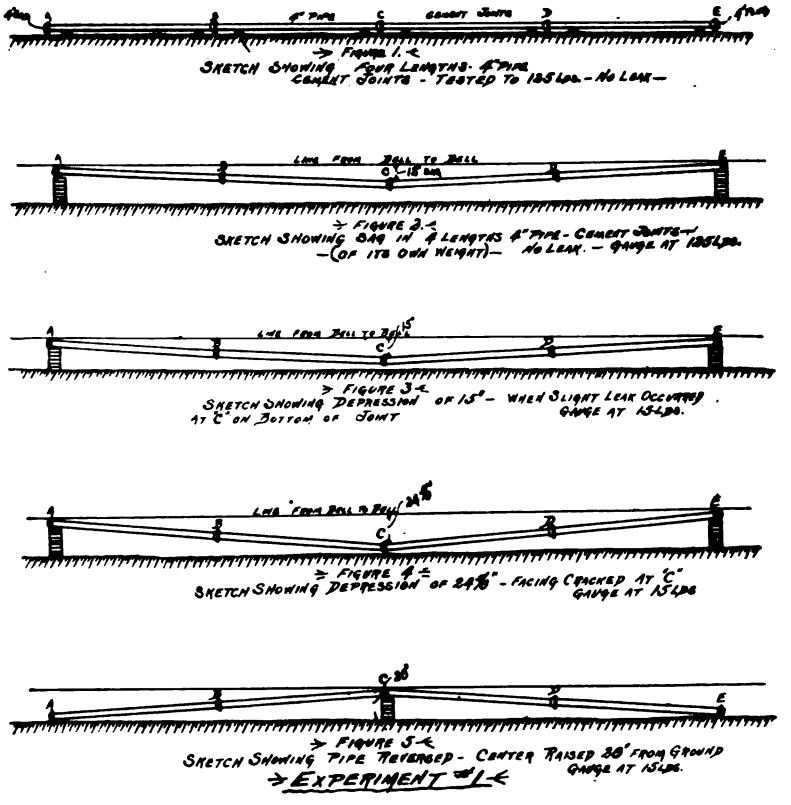
"The two ends were gradually elevated until they were 25 inches above the ground level, then the center blocking was removed and the pipe allowed to sag in the middle. It was found that the sag amounted to 12 inches.

"In order to find the point of fracture in the facing of the joints, the pipe was gradually weighted down until at a sag of 15

inches a slight leak in the bottom was discovered where the cement began to lose amalgamation with the iron. Additional weights were placed upon it until the pipe reached the ground, which sag amounted to 24⅝ inches, as per sketch. The facing then cracked in several places.

"The process was then reversed, the two ends being left free, the blocks being placed in the middle. It was found that when the curve was reversed the leak in the bottom stopped and for a while the joint was tight again. This reversed process was continued until the center was at a height of 28 inches from the

Sketches Illustrating Experiment No. 1.


A
B
4" Pipe
C
Cement Joints
D
E
4" Pipe
Figure 1.
Sketch Showing Four Lengths 4" Pipe, Cement Joints - Tested to 135 Lbs. - No Leak -
Line from Bell to Bell
C - 18" Sag
Figure 2.
Sketch Showing Sag in 4 Lengths 4" Pipe - Cement Joints - (of its own weight) - No Leak. - Gauge at 135 Lbs.
Line from Bell to Bell
15"
Figure 3.
Sketch Showing Depression of 15" - when Slight Leak Occurred at "C" on Bottom of Joint
Gauge at 135 Lbs.
Line from Bell to Bell
24⅝"
Figure 4.
Sketch Showing Depression of 24⅝" - Facing Cracked at "C"
Gauge at 135 Lbs.
28"
Figure 5.
Sketch Showing Pipe Reversed - Center Raised 28" from Ground
Gauge at 135 Lbs.
Experiment No. 1.

NOTE:- Joint C is shown distorted. Actually, the four lengths, formed almost a perfect curve.

ground. The free ends were then swinging in the air, and, in order to keep them on the ground, weights were placed upon them.

"There was only one joint that was in any visible way disturbed during the whole test, and that was the center one. As a final test the whole 4 lengths were again blocked up to a height of 24 inches and then pushed off and allowed to drop the entire distance to the ground, and even after this shock no fractures were apparent in the joints. A few photographs of the test were taken and will be furnished to you in a few days."

Illustrations Showing Experiment No. 1.

Special 4 Inch Test, Cement Joints, Tested to 125 Pounds, Showing Depression of 2 4/8 Inches at Central Joint "C.," Sept. 22, 1904.

Second—Lucky Street, 6-Inch Main.

"I beg leave to submit the following report, complying with the letter of the Superintendent of the Street Department in regard to a special test, in order to see if cement joints could withstand a pressure of 50 pounds.

"We took 3 lengths of 6-inch pipe, a plug and a cap, in all 4 joints, and used "Star" cement in the following proportions:

Joints.	Cement.	Water.
1	2 quarts.	1½ pints.
2	2 "	1½ "
3	2 "	1⅝ "
4	2 "	1⅔ "

One-fourth gill of muriate of ammonia.

"The last solution was made as an experiment to see what the effect of the ammonia salt would be on the joint, and its action upon the cement.

Special 4-Inch Test, Cement Joints, Showing Depressed Joint, Central Joint "C," after Depression of 24⅝ Inches. Sept. 22, 1904.

"These 4 joints were thoroughly caulked and rammed, and after being allowed to set for 40 hours were then subjected to a pressure of 24 pounds, and this was gradually increased until the gauge stood at 100 pounds, which pressure was maintained for half an hour.

"The joints were thoroughly inspected and tested while the pressure was being applied, and even at this high figure no perceptible leak was discovered nor was a variation of the gauge

visible. The pressure was not increased beyond this figure for fear of an accident happening, due to the enormous pressure."

Third—Old Manchester Road, 6-Inch.

"As you requested, I put 165 feet of 6-inch pipe together for an experimental test. The test was made in the following manner:

"A 10-pound pressure was put on, then each joint examined carefully; after that 5 pounds at a time, each time thoroughly tested, until we had 50 pounds pressure, which was all the pump would supply, and still no leak.

Testing Engine, Capacity 125 Pounds, Aug. 3, 1904.

"Five ounces of yarn were used to a joint, 9 or 10 strands to the first yarn, which was driven back solid. The joint was then filled and a second yarn of 11 or 12 strands put in and driven hard. The joint was then faced with a thin layer of cement.

"The cement used for this test was 'Red Ring,' and was mixed 1½ quarts of cement to 1 pint of water; the cement then set 72 hours before it was tested."

Fourth—Report from Washington University.

"Six-inch pipe with lead joint was tested at Washington

University in order to determine at what pressure the lead would give way. The following are the results: At 13,900 pounds pressure the lead moved; at 24,740 pounds pressure the iron broke.

"With a cement joint: At 29,450 pounds the cement cracked on the outside; at 32,000 pounds the iron broke.

"Holes were drilled into the 6-inch pipe to facilitate making the test of the joints, so that the tension at which pipe broke

Special 6-Inch Test, Cement Joints, Tested to 100 Pounds, Laid in 24-Inch Trench. Aug. 31, 1904.

does not represent the total tensile strength of the iron. The test is given simply to show the relative strength of lead and cement joints."

Fifth—Vandeventer Avenue.

One thousand feet of 10-inch was laid with cement joints and tested to 50 pounds, without showing any leak. The soil was saturated with water.

Sixth—Sarah Street—12-Inch Line Running from Sarah to Easton:

"The following are details of a test which was put on the new high pressure 12-inch line on Sarah street.

"The section of pipe tested consists of 19 lengths of standard 12-inch pipe joined together with cement. The joints—20 in all—including the end which was plugged—were cement. On Friday, September 16, 1904, and 24 hours after the last joint was

Test Pump and Gauge—Special 6-Inch Test Gauge at 25 Pounds. Aug. 31, 1904.

made, a test pressure of 10 pounds to the square inch was put on the line with the result that all the cement joints, with the exception of 2, showed no sign of a leak. The 2 which did leak were made by a new man, which probably accounts for their not holding as well as they should have."

Seventh—Osceola Street—16-Inch Pipe:

"A test was made of the joints on the 16-inch main on Osceola

street between Broadway and Minnesota, with a pressure of 4½ pounds.

"Ninety-three cement and 18 lead joints were tested. The pressure was on for 1 hour, during which time it lost only 1-tenth of an inch. This was due to leaks in plugs at either end of the line, the joints of which were made of plaster of paris."

Eighth—Lynch Street—20-Inch Pipe:

"Yesterday a test was made on a section of the new 20-inch main on Lynch street. There were 36 lengths of pipe with 16 lead and 21 cement joints. The test lasted 1½ hours and not a joint leaked under a pressure of 12 pounds."

Ninth—24-Inch, High Pressure on Lucky Street:

"I beg leave to submit the following report concerning the cement joint tests make on the 24-inch high pressure line on Lucky street. The brand of cement used is known as 'Star,' and the following operation and proportions were used:

"The bell and spigot of each pipe were thoroughly washed and cleaned of all foreign material and then placed home. A grouted yarn of 6 strands was thoroughly caulked into place, after which was placed cement of the following proportions: Cement, 5 quarts; water 1½ quarts plus 1 gill. This amount of cement is sufficient to finish the entire joint, which includes filling and facing. After the cement batter is placed in the joint, by hand, a caulking tool of the third size is used and the cement then thoroughly rammed. A second yarn of 7 strands is then put in dry and driven back with the same caulking tool and a hammer. The joint is then faced.

"The whole job, consisting of 15 joints, including the cap and plug, after setting 27 hours, was subjected to a test of 10 pounds of air and the joints all examined and tested with soapsuds. As everything was found to be in perfect condition, the pressure was gradually raised to 25 pounds and maintained at this figure for 1 hour, without any visible sign of a leak or variation in the gauge reading.

"Since this test was make we have found it necessary to use 8 quarts of cement to 2 quarts plus ½ pint water. This additional amount is due to larger joints and hard driving of the cement. On one of our tests a few joints were seen to 'sweat' at 15 pounds. In order to see if 'patching' would be feasible in this case a trial was made, but it was found a flat failure."

Tenth—24-Inch, High Pressure on Lucky Street.

"I beg leave to submit the following report concerning the test on the 24-inch high pressure main on Lucky street. There were in all 56 cement joints, and the cement used was of 3 different grades, viz., 'Star,' 'Red Ring' and 'Dyckerhoff.'

"It was noticed that the last named brand took about ½ pint more water to the customary 8 quarts of cement than we are accustomed to use; otherwise, the standard proportions as already reported were used.

"These joints were allowed to set for 40 hours and then a test of 15 pounds was applied and the line was found to be tight, without a single leak or sweat."

Eleventh—24-Inch, High Pressure on Magazine Street:

"I beg to submit the following report concerning the test on the 24-inch high pressure line on Magazine street and Webster avenue. There were in all 60 cement joints mixed in the following proportions: Cement, 8½ quarts; water 2 quarts, plus 3½ gills. After these joints had been allowed to set for 36 hours we applied a test of 20 pounds per square inch and found the line tight in every respect. The brand of cement used is known as 'Red Ring.'"

Twelfth:

"On Broadway, 31 lengths of 30-inch pipe were tested to a pressure of 30 pounds. the gauge being allowed to stand 2 hours without showing any drop. The joints were also tested with soapsuds and no leaks were found. The cement used was the 'Star' cement.

"A test was made of 88 cement and 20 lead joints on the 16-inch main on Osceola street, between Minnesota and Virginia avenues, with a pressure of ten pounds. The pressure was left on for 1 hour and 40 minutes, during which time each joint was tested with soap and water. At the expiration of the time the gauge still registered the full 10 pounds.

"The following day, after the 16-inch main on Osceola street had been connected to the main which Nicholson is laying on Virginia avenue, a 5-pound pressure was put on both lines. The gauge again remained stationary, not varying in the slightest degree. The pressure was left on for 1 hour."

Thirteenth:

"The following is a test on the 24-inch main on King's Highway, south of Chouteau (11 lead joints and 14 cement joints).

No. of Joints. Cement.	Lead.	Pressure Pounds per Sq. Inch.	Duration of Test.	Length of Time Last Joint was Made Before Test.
14	11	16	3 hours.	40 hours.

Temperature at which Joints were Made.	Kind of Cement Used.	Foreman in Charge of Work.
16 to 24° F.	"Star" and "Red Ring." in equal parts	Wm. Farrell.

NOTE—Warm water was used in mixing thecement.

Fourteenth:

The following is the test made on the cement joints on 12-inch main on Magnolia street, between Lawrence and Vandeventer:

No. of Joints.	Pressure Pounds per Square Inch.	Duration of Test.	Length of Time Joints were Made before Test.	Kind of Cement Used.	Foreman in Charge of Work.	Temp. at which Cement was Mixed.
88	20 lbs.	1 hr.	65 hrs.	"Star."	S. Williams.	33 to 50°

Fifteenth:

The following is a test on 12-inch main on the north side of Magnolia between Spring and Grand:

No. of Joints.	Pressure Lbs. per Sq. in.	Duration of Test.	Length of Time Last Jt, was Made Before Test.	Temperature at which Cement was Mixed.	Kind of Cement Used.
64	20	1½ hrs.	40 hrs.	33 to 50°	"Red Ring."

Sixteenth:

"A test of 4-inch cement joints, which had been made when the thermometer registered 31° F., was made to see what effect freezing weather would have upon the cement. Ten lengths of pipe were laid for the test and the joints were made with 'Star' cement. In every case the water used in mixing the cement had been slightly warmed. Immediately upon the completion of every joint, it was wrapped with a sack and covered with a layer of dirt about 8 inches deep. After a 40-hour set (from Saturday afternoon until Monday morning) an air pressure of 10 pounds was put on the joints, which was then tested with soapsuds for leaks. The pressure was then raised to 20 pounds and the joints were again tested with soapsuds. In neither case was there a leak found. The pressure was again raised, this time to 30 pounds. When this pressure had been on an hour a final test

was made with soapsuds, and again no leaks were found. The results of this test would warrant the statement that cement joints are not affected by moderately cold weather."

It will be noted that these are reports of actual tests made by various foremen and street clerks throughout the city, and the reports are given verbatim. The last 7 tests were made in order to determine whether it was safe to make joints in freezing weather. Under ordinary conditions, if proper care is used, it would appear from these few experiments that it is perfectly safe to make cement joints when the thermometer registers as low as the freezing point. The above test, together with a number of others, as shown in detail Table No. 1.

Now, referring to the 10 items on pp. 922-923, under the head of "Discussions," the answers received which were unfavorable to the use of cement came from cities where cement had never been tried very extensively. Of the reports from 52 cities only 10 used cement entirely and 19 almost entirely, whereas 23 do not use cement. In view of the favorable results obtained in 29 cities, together with the experience in St. Louis, as shown in the various tables and experiments, it does seem that the great saving and advantages to be gained by using cement joints are not fully appreciated. Table No. 4 shows the saving in money, per mile of pipe laid, for each size.

Another great advantage is the fact that a cement joint offers more resistance for the passage of electric current than a lead joint does. Mr. E. E. Brownell, in his "Electrolytic Survey of the City of St. Louis," cites an example of a 6-inch main 100 feet long, which being tested showed a resistance of 12,000 ohms.

In order to get some idea as to the relative resistance of the various kinds of joints, an experiment was made in St. Louis by making up 4 short pieces of 4-inch, cast iron pipe. The first two joints were made with an asbestos gasket in the back of the bell to prevent the spigot from touching the bell. The joints were made with cement in the usual manner. The third joint was an ordinary cement joint without the asbestos gasket, while the fourth joint was made of lead in the usual manner. A report of the test is shown below:

Joint No. 1, of asbestos and cement, shows a resistance of 18.2 ohms; No. 2, of asbestos and cement, shows a resistance of 19.18

ohms; No 3, of cement, shows a resistance of 17.64; No. 4, of lead, shows a resistance of .000385 ohms.

TABLE NO. 1.—*Showing Results of Tests, Cement Joints, Different Sizes of Pipe.—St. Louis, Mo.*

Number of Test	Size of Pipe	Number of Cement Joints in Test	Number of Lead Joints in Test	Pressure used in Pounds	Equivalent Pressure in Inches of Water	Kind of Cement Used	Amount of Cement in Pounds	Amount of Water used in Parts	Date of Test 1906	High Pressure or Low Pressure	Remarks
1	4"	5	0	135#	3738.7	STAR	2	1 1/3	SEPT. 22	SPECIAL TEST	SPECIAL TEST - 5 JOINTS - 125# FOR 30 MIN. - NO LEAKS.
2	4"	11	0	20#	554.2	STAR	2	1 1/3	DEC. 7	L.P.	TEMP. 31° - WARM WATER USED - NO LEAKS -
3	6"	30	0	4#	110.8	STAR	1 1/4	1 1/5	AUG. 25	L.P.	SMALL PIN HOLE LEAKS DROP INCREASE TO 3# IN 2 1/2 HRS.
4	6"	2 Pipes 5 Joints	0	100#	2771.0	STAR	2	1 1/2	AUG. 31	SPECIAL	SPECIAL TEST 3 LEAKERS
"	6"	#2	0	100#	2771.0	STAR	2	1 1/2	"	"	5 PIPES - JOINTS MADE DIFFERENTLY - 100# TEST - FOR 1/2 HOUR - NO LEAKS -
"	6"	#3	0	100#	2771.0	STAR	2	1 1/2	"	"	
"	6"	#4	0	100#	2771.0	STAR	2	1 1/2	"	"	1/8 GILL AMMONIA USED ON 1 JOINT
5	6"	14	0	50#	1385.5	RED RING	1 1/2	1 1/2	SEP. 1	L.P.	NO LEAKS
6	6"	100	0	2 1/2#	69.3	STAR	1 1/2	1 1/4	SEP. 4	L.P.	TEST 3 HRS. NO LEAKS
7	10"	84	0	5#	138.5	⊛	2 1/2	1 1/2	NOV.	L.P.	⊛ ST. LOUIS PAT. X HAMMERMILL SOIL SAT. WITH WATER - NO LEAKS
8	12"	101	0	5#	138.5	STAR	3	2 1/4	NOV.	L.P.	NO LEAKS
9	12"	20	0	10#	277.1	STAR	3	2 1/4	SEP.	H.P.	2 JOINTS LEAKED
10	12"	100	0	2 1/2#	69.3	STAR	4	2 1/2	SEP. 4	L.P.	TEST FOR 3 HRS. NO LEAKS
11	12"	88	0	20#	554.2	STAR	4	2 1/2	NOV. 29	L.P.	TEMP. 33° TO 30° NO LEAKS
12	12"	64	0	20#	554.2	RED RING	4	2 1/2	DEC. 29	L.P.	NO LEAKS
13	12"	46	0	20#	554.2	RED RING	4	2 1/2	DEC. 15	L.P.	NO LEAKS
14	12"	51	4	20#	554.2	⊛	4	2 1/2	NOV. 22	L.P.	⊛ RED RING & STAR - EQUAL TESTS NO LEAKS
15	16"	93	18	4 1/2#	124.7	STAR	4	2 1/2	SEP. 24	L.P.	TEST 1 HOUR LEAKS ONLY AT PLUGS IN ENDS
16	16"	32	3	5#	138.5	STAR	4	2 1/2	SEP. 24	L.P.	CEMENT JOINTS HELD TIGHT 1 SLIGHT LEAK IN LEAD JOINT
17	16"	88	20	10#	277.1	STAR	4	2 1/2	SEP.	L.P.	TEST 1 HOUR 40 MINUTES NO LEAKS
18	20"	42	0	5#	138.5	STAR	5	3	SEP. 20	L.P.	NO LEAKS
19	20"	21	16	12#	332.5	STAR	5	3	SEP. 29	L.P.	TEST 1 1/2 HOURS NO LEAKS
20	24"	15	0	25#	692.7	STAR	5	3	AUG. 24	H.P.	TEST 1 HOUR NO LEAKS
21	24"	47	0	23 1/2#	623.5	STAR	8 1/2	5	SEP. 10	H.P.	NO LEAKS
22	24"	56	0	15#	415.6	⊛	8 1/2	5	SEP. 6	H.P.	⊛ STAR - RED RING - DYKERHOFF NO LEAKS
23	24"	51	0	13 1/2#	346.4	STAR	8	5	AUG. 27	H.P.	SIX LEAKY JOINTS
24	24"	37	0	15#	415.6	STAR	8	5	SEP.	H.P.	FOUR LEAKY JOINTS
25	24"	60	0	20#	554.2	RED RING	8 1/2	5	SEP. 26	H.P.	NO LEAKS
26	24"	14	11	16#	443.4	⊛	8	5	DEC. 15	H.P.	⊛ STAR X RED RING - EQUAL TESTS TEMP. 16° TO 34° - NO LEAKS
27	24"	37	14	15#	415.6	⊛	8	5	DEC. 9	H.P.	⊛ STAR X RED RING - EQUAL TESTS NO LEAKS
28	24"	40	0	40#	1108.4	RED RING	10	5 1/2	OCT. 1	H.P.	NO LEAKS
29	24"	82	0	17 1/2#	484.9	STAR	8	5	SEP. 14	H.P.	8 SLIGHT LEAKS
30	24"	22	16	20#	554.2	STAR	8	5 1/4	SEP. 19	H.P.	NO LEAKS
31	24"	44	4	17#	471.1	⊛	8	5	NOV. 25	H.P.	⊛ RED RING X STAR - EQUAL TESTS 2 SLIGHT LEAKS ON TOP OF JOINTS
32	30"	31	0	30#	831.3	STAR	7	4 1/2		L.P.	NO LEAKS - TEST 2 HRS.
33	30"	31	0	10#	277.1	STAR	7	4 1/2		L.P.	NO LEAKS - TEST 3 HRS.
34	30"	35	0	10#	277.1	STAR	7	4 1/2		L.P.	NO LEAKS - TEST 2 HRS.
35	30"	70	0	10#	277.1	STAR	7	4 1/2		L.P.	NO LEAKS - TEST 3 HRS.

NOTE—All tests made with air. 16-inch and 30-inch bells. Lead space very small.

This test certainly shows that a cement joint has a great advantage over a lead joint from a purely electrolytic standpoint. The third advantage is the fact that the work can be done with unskilled labor; and, fourth, a cement joint is less liable to leakage than a lead joint. This latter I consider the greatest advantage of all.

TABLE NO. 2.—*Showing Cost of Cement and Lead Joints and Saving per Joint in Cement over Lead.*

SIZE OF JOINT	CEMENT JOINTS				LEAD JOINTS				SAVING PER JOINT IN CEMENT OVER LEAD
	CEMENT	YARN	LABOR	TOTAL	LEAD	YARN	LABOR	TOTAL	
4"	.02	.012	.04	.072	.375	.008	.075	.458	.386
6"	.03	.02	.065	.115	.50	.01	.10	.61	.495
8"	.04	.025	.10	.165	.75	.015	.125	.890	.725
10"	.05	.03	.135	.215	.95	.02	.15	1.12	.905
12"	.06	.037	.17	.267	1.15	.03	.20	1.38	1.113
16"	.08	.05	.20	.33	1.50	.03	.30	1.83	1.50
20"	.10	.057	.30	.457	1.875	.037	.40	2.355	1.895
24"	.13	.068	.44	.638	3.00	.044	.66	3.704	3.066
30"	.14	.085	.55	.775	3.60	.055	.83	4.485	3.71

Second Item.—There seems to be a prejudice against the use of cement in the business sections of the very large cities. I am unable to account for this prejudice, because my experience with lead joints, both in St. Louis and other cities, has been that the largest number of broken mains has occurred in the business section of the city and were laid with lead joints. Last year we had over 100 broken gas mains, over 75 per cent. of which were in the business section of the city, and in every case the joints were made with lead. We have no records showing any broken mains where the joints were made with cement. although there are a great many miles of such mains in St. Louis, which have been laid for a great many years. Last year we laid 60 miles of pipe with cement joints and 35 miles with lead joints, but at this writing we have had only one slight leak on the entire amount of pipe laid.

Amount of lead used in this table is calculated from standard dimensions of pipe and should be the minimum amount used. Table No. 1 is based on actual amounts used in St. Louis.

This remark applies to Table No. 2-A and 4-A also.

These quantities are actual, as used in St. Louis, Mo., giving good results.

Proportion of water to cement should be in ratio of about 1 to 4.

Actual quantities will vary according to size of bell.

TABLE NO. 2-A.—*Showing Cost of Cement and Lead Joints and Saving per Joint in Cement over Lead.*

SIZE OF PIPE	CEMENT JOINTS				LEAD JOINTS				SAVING PER JOINT IN CEMENT OVER LEAD
	CEMENT	YARN	LABOR	TOTAL	LEAD	YARN	LABOR	TOTAL	
4"	.02	.012	.04	.072	25	.008	.075	333	.261
6"	.03	.02	.065	.115	.30	.01	10	.41	.295
8"	.04	.025	.10	.165	40	.015	.125	.54	.375
10"	.05	.03	.135	.215	.60	.02	.15	.77	.555
12"	.06	.037	.17	.267	.80	.035	20	1.035	.768
16"	.08	.05	.20	.33	1.25	.04	.30	1.59	1.26
20"	.10	.057	.30	.457	1.88	.047	.40	2.327	1.87
24"	.13	.068	.44	.638	2.50	.06	.66	3.22	2.582
30"	.14	.085	.55	.775	3.25	.07	.83	4.15	3.375

The writer claims that if a main is properly laid with 4 feet of cover, and so as to have an even bearing, as shown in Fig. 1, and not as shown in Fig. 2, there will be less likelihood of a leak or a break with cement than if lead is used; and it is our intention during the coming season to use cement joints in the business section of St. Louis as well as in the suburban part of the city.

Fourth and Fifth Items.—Regarding the kind of cement to be used, our experience as well as that of other cities shows it is immaterial what brand is used. Any good American Portland cement will give good results, and as it is cheaper to use the

TABLE NO. 3.—*Of Approximate Quantities for Cement and Lead Joints.*

	CEMENT JOINTS				LEAD JOINTS	
SIZE OF PIPE	CEMENT IN QUARTS	CEMENT IN POUNDS	WATER IN PINTS	YARN IN OUNCES	POUNDS OF LEAD	YARN IN OUNCES
4"	1 TO 1½	3.25 TO 4.10	⅘ TO 1⅓	4	7½	2½
6"	1½ TO 2	4.10 TO 5.50	1¼ TO 1⅝	6	10	3½
8"	2 TO 2½	5.50 TO 6.87	1¼ TO 1½	8	15	5
10"	2½ TO 3	6.87 TO 8.25.	1½ TO 2	10	19	7
12"	3 TO 4	8.25 TO 11	2 TO 2½	12	23	9
16"	4 TO 5	11 TO 13¾	2¼ TO 2½	15	30	9
20"	5 TO 6	13.75 TO 16.50	2½ TO 3½	20	37½	10
24"	8 TO 8½	20 TO 23.38	5 TO 5½	27	60	16
30"	7 TO 7½	19.25 TO 20.62	4 TO 4½	27	72	17

NOTE—Lead space in 16-inch bells was very small.
Lead space in 24-inch bells was very large.

domestic than the foreign brands, there is no good reason for using the latter. Rosendale cement may give good results, but it is considered good engineering to always use Portland cement below the surface of the ground, and as the difference in cost is trifling, I can see no advantage in using the Rosendale.

I would suggest, however, to those who have never used cement for joint making purposes that they start with Dyckerhoff cement, and as the men become more efficient in their workmanship a cheaper brand of Portland cement can be substituted.

TABLE No. 3-A.—*Of Approximate Quantities for Cement and Lead Joints.*

	CEMENT JOINTS				LEAD JOINTS	
SIZE OF PIPE	CEMENT IN QUARTS	CEMENT IN POUNDS	WATER IN PINTS	YARN IN OUNCES	POUNDS OF LEAD	YARN IN OUNCES
4"	1 TO 1½	2.25 TO 4.10	⅘ TO 1⅓	4	5	3¼
6"	1½ TO 2	4.10 TO 5.50	1¼ TO 1⅝	6	6	4¾
8"	2 TO 2½	5.50 TO 6.87	1¼ TO 1½	8	8	5¾
10"	2½ TO 3	6.87 TO 8.25	1½ TO 2	10	12	6½
12"	3 TO 4	8.25 TO 11	2 TO 2½	12	16	10
16"	4 TO 5	11 TO 13.75	2¼ TO 2½	15	25	13
20"	5 TO 6	13.75 TO 16.50	2½ TO 3½	20	37½	14½
24"	8 TO 8½	20 TO 23.38	5 TO 5½	27	50	21½
30"	7 TO 7½	19.25 TO 20.62	4 TO 4½	27	65	21½

Tables Nos. 5 and 6 show the properties of the various makes of cement. The information was furnished by Mr. W. Purves Taylor, Engineer of Test, Bureau of Surveys, Philadelphia, and Mr. W. H. Henby, Engineer of Tests, Water Department, St. Louis.

Portland cement in barrels weighs 400 pounds gross, 380 pounds net, 4 bags to the barrel; natural cement in barrels weighs 300 pounds gross, 280 pounds net, 3 bags to the barrel; Portland cement only contains 3.6 cubic feet packed and 4 cubic feet loose.

It is best to buy cement in barrels rather than bags, in case the cement is to be stored.

TABLE NO. 4.—*Showing Approximate Saving per Mile of Main.*

SIZE	SAVING PER MILE.
4"	$ 170.00.
6"	218.00.
8"	319.00.
10"	398.00.
12"	490.00.
16"	660.00.
20"	834.00.
24"	1249.00.
30"	1632.00.

TABLE NO. 4-A—*Showing Approximate Saving per Mile of Main.*

SIZE	SAVING PER MILE
4"	$ 114.80
6"	129.80
8"	165.00
10"	244.20
12"	337.92
16"	554.40
20"	822.80
24"	1137.08
30"	1485.00
	H.W.H.

See note under table No. 2-a.

Sixth Item.—Referring to provision for expansion, I agree thoroughly with Mr. Forstall, of Philadelphia, that it is not necessary to provide for expansion. A survey of the answers will show that lead joints are inserted every 4th or 5th joint in some cities and 1 lead joint to the block in others. Surely if 1 lead joint to the block is sufficient, then 1 lead joint in every 5th or 6th joint is more than sufficient. It would be interesting to

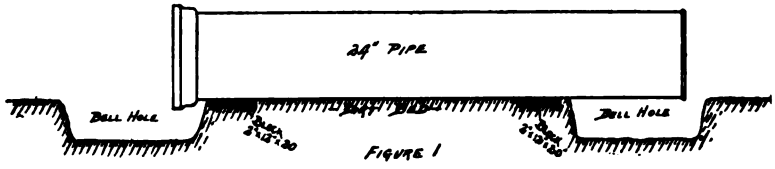


FIGURE 1

CORRECT PIPE BEDDING — BLOCKING COUNTERSUNK.

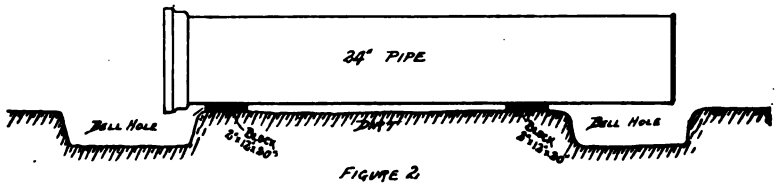


FIGURE 2.

INCORRECT PIPE BEDDING — BLOCKING ON TOP OF DIRT

have some of the members explain just why they insert the exact number of joints which they do, as there must be some reason for so doing. Frost in St. Louis last winter reached a depth of 3 feet to 3 feet and 6 inches.

Our experience, of course, is all based on 4 feet of cover, and it may be that if the pipes are laid with a less cover it would be necessary to make some provision for expansion. Two years ago we laid some 10 miles of 3-inch wrought iron pipe in cement and pitch and made no provision for expansion. This pipe is under a constant pressure of 250 pounds to the square inch, and yet has never shown any leaks at the joints.

Seventh Item.—It seems the generally accepted opinion that cement should not be laid in soft places, the idea being that the the pipe might settle, and on account of the rigidity of a cement joint leaks would develop more rapidly than with lead joints. In the face of experiment No. 1 it would seem that there is a great deal more elasticity in a pipe line laid with cement joints than has

[illegible]

[illegible]

Brand	Number of Samples	Number of Briquettes	Neat			Specific Gravity	Setting		Per Cent Water	Tensile Strength per Square Inch				Remarks
			30	90	365		Time in the Water	Temperature		Neat				
							Initial / Final	F°						
*Commercial Portland	10	1	220	220	0.0	[illegible]	10 / 10	70 / 70	[illegible]	440	0	150	320	395	390	Sample of Portland Cement
*Improved Portland	10	1	200	200	0.0	0.0	0.0	[illegible]	10	5	70 / 70	420	0	135	320	330	390	[illegible]
*Improved Jamestown	350	1	2000	2250	0.0	0.0	0.0	[illegible]	1	0	70 / 70	420	0	115	290	330	395	[illegible]
Improved Shield		0	0	0	0.0	0.0	0.0	[illegible]	1	0	70 / 70	420	0	117	290	370		[illegible]
*Improved Vulcan	1	1	100	100	0.0	0.0	0.0	[illegible]			70 / 70	420	0	211	280	320	390	[illegible]
Improved Warner			0	0	0.0	0.0	0.0	[illegible]	50	200	70 / 70	420	0	30	100	180		[illegible]
Alpha	10	0	[illegible]	[illegible]	0.0	0.0	[illegible]	[illegible]	30	120	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
*Atlas	2	2	50	20	0.0	0.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Columbia	1		0	0	0.0	0.0	[illegible]	[illegible]	0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
Dexter	2	0	20	20	0.0	0.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
Dragon	32	0	270	180	0.0	0.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
*Giant	693	6	3290	2710	0.0	0.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Helderberg	1	0	10	10	0.0	0.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
*Hemmoor	29	11	250	220	0.0	0.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
*Krause's	11	0	170	110	0.0	0.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
*Lehigh	732	46	5630	4980	0.0	0.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Nazareth	3	0	40	30	0.0	0.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
Northampton	9	0	120	100	0.0	0.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Phoenix	7	0	90	80	0.0	0.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
*Saturn	7	2	90	80	0.0	0.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
*Saylor's	71	4	580	490	0.0	0.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
*Star	705	19	5180	4300	0.0	0.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Vulcanite	7	0	90	80	0.0	0.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
*Whitefall	85	3	670	540	0.0	0.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

* Rise in temperature of paste during setting.
a Average of accepted cement
g German.

TABLE No. 6.

Brand	Per Cent Fineness (f)	Condition of Pats. boiling (g)	Setting		Ultimate tensile strength in lbs. per □in.						Remarks
			Initial	Final	Neat		1 to 3 Mississippi river sand				
			Minutes (3)	Minutes (e)	7 Days (c)	28 Days (b)	7 Days (r)	28 Days (a)	3 Mos. (q)	6 Mos. (n)	(4)
Hannibal Atlas	92.1	O.K.	76	238	750	541	300	385	432	429	
Red Ring	90.9	O.K.	56	264	811	933	324	414	429	443	

1, 2, 3, 4, 5 and 7 are average of 50 lots
9 is " " 42 "
6 and 8 " " 32 "
10 is " " 21 "
11 " " 6 "
1, 2, 3, 4, 5, 7 and 9 " " 50 "
6 " 8 " " 38 "
10 is " " 37 "
11 " " 7 "

[illegible]

[illegible]

[illegible]

Atlanta, Ga. Almost entirely.

Baltimore, Md. We are using cement joints in the suburbs and out-lying districts, but not in the city proper. Our reasons for not laying this cement in the city is on account of the probability of a sewerage system being installed by the city within a few years.

Boston, Mass. Boston Gas Light Co. In solid ground we use cement joints and at all crossings. We use lead joints one in five on a run of pipe. In made ground every other joint is lead, and in very bad ground we use all lead joints, except at street crossings or under street car tracks, where cement joints are used.

Dorchester Gas Light Co. Have used cement joints for gas mains in the proportion to two cement joints to one lead joint.

Bridgeport, Conn. About 99% of joints are cement. A few, where pipe is laid in inaccessible places, are lead.

Brooklyn, N. Y. Do not use cement.

Butte, Montana. Use cement for repairing broken pipes and leaks of every kind, and find cement far ahead of any other material for this purpose. Should we lay any large pipe in the future, we will undoubtedly use cement for joints.

Chester, Pa. We have absolutely and entirely done away with the making of lead joints. We are coating all our wrought iron pipe with cement as a protection against electrolysis.

Cincinnati, O. Do not use cement.

Cleveland, O. Do not use cement.

Dallas, Texas. Lead used at present; expect to use cement in the future.

Danbury, Conn. Use cement for everything except intersections and bridges.

Denver, Colo.

Derby, Conn. Use cement exclusively.

Des Moines, Iowa. Cement joints are used exclusively for laying mains in Des Moines, except in an occasional instance where the appearance of water in a ditch necessitates the use of lead on account of difficulty in getting cement to set.

Fall River, Mass. We are using cement joints in the laying of all mains in this city, from the smallest to the largest which is from 4 inches to 20 inches.

Grand Rapids, Mich. We make all the joints of our city mains out of cement; use no lead whatever.

Houston, Texas. We are making all cement joints in laying mains at the present time.

Jackson, Miss. Do not use cement.

Louisville, Ky. Do not use cement.

Lowell, Mass. Use cement exclusively.

Memphis, Tenn. Do not use cement.

Milwaukee, Wis. Do not use cement.

Mt. Vernon, N. Y. All joints are made with Dyckerhoff Portland cement.

New Orleans, La. Use cement almost exclusively.

New York City. Do not use cement.

Paterson, N. J. Use cement exclusively.

Peoria, Ill. Do not use cement.

Philadelphia, Pa. Forstall. About nine-tenths of each year's mileage is laid with cement joints.

Norris. We are using cement almost exclusively for the smaller sizes of pipes, except in the congested districts of very large cities.

Pittsburg, Pa. Use cement exclusively.

Portland, Me. Do not use cement at present, but believe it far superior to lead.

Reading, Pa. Use cement exclusively.

Richmond, Va. Do not use cement.

Rochester, N. Y. Do not use cement, but engineer believes it far superior to lead.

St. Augustine, Fla. Use cement for joints. (Does not say in what proportion to lead.)

St. Paul, Minn. Do not use cement.

San Francisco, Cal. Do not use cement on account of poor ground.

Savannah, Ga. All mains are laid with cement joints.

Scranton, Pa. Just started to use cement for joints.

Stapleton, N. Y. Use cement exclusively, except in occasional wet trenches where it is impracticable to make a cement joint.

Stockton, Cal. Do not use cement.

Waterbury, Conn. About 25% of the mains now in use have cement joints.

Question No. 2—For how many years have you been using cement?

Atlanta, Ga. Fifteen years.

Baltimore, Md. One year.

Boston, Mass. Boston Gas Light Co. Over thirty years.

Dorchester Gas Light Co. has used cement since it started.

Bridgeport, Conn. Forty years.

Brooklyn, N. Y. Do not use cement.

Butte, Montana. Have not used cement except to repair breaks.

Chester, Pa. Five years.

Cincinnati, O. Do not use cement.

Cleveland, O. Do not use cement.

Dallas, Texas. (?)

Danbury, Conn. Forty-seven years.

Denver, Colo. (?)

Derby, Conn. Fifteen years.

Des Moines, Iowa. Twenty years.

Fall River, Mass. Since the company started in business. The present manager has used it for fourteen years.

Grand Rapids, Mich. Eight years.

Houston, Texas. Eight years.

Jackson, Miss. Do not use.

Louisville, Ky. Do not use.

Lowell, Mass. Fifty-five years.

Memphis, Tenn. Do not use.

Milwaukee, Wis. Do not use.

Mt. Vernon, N. Y. Ten years. We are gradually abandoning old 3-inch mains from the city of Mt. Vernon, which are being replaced by 8-inch mains, due to the growth of the city, and am pleased to say that these mains were laid some thirty years ago with cement joints and are absolutely tight.

New Orleans, La. Exclusively for three years; partly for twenty-five years or more.

New York City. Do not use cement.

Paterson, N. J. Six years.

Peoria, Ill. Do not use cement.

Philadelphia, Pa. Norris. Have been using cement in some places for at least twenty years, including New England cities.

Forstall. Five years.

Pittsburg, Pa. For fifty years.

Portland, Me. Do not use cement.

Reading, Pa. Ten years.

Richmond, Va. Do not use.

Rochester, N. Y. Seven or eight years.

St. Augustine, Fla. ? Several years.

St. Paul, Minn. Do not use.

San Francisco, Cal. Do not use.

Savannah, Ga. Six or seven years.

Scranton, Pa. One year.

Stapleton, N. Y. Over three years.

Stockton, Cal. Do not use.

Waterbury, Conn. Ten years.

Question No. 3--Have leaks in gas mains increased or decreased since you started to use cement for the joints instead of lead?

Atlanta, Ga. Decreased.

Baltimore, Md. Have not used cement long enough to determine by experience, but have reasons to believe that leaks will decrease where cement is used.

Boston, Mass. Boston Gas Light Co. Have always used cement.

Dorchester Gas Light Co. Have always used cement in this company, so cannot answer this question, but am positive a change from lead to cement would not increase the leakage.

Bridgeport, Conn. Have always used cement.

Brooklyn, N. Y. Have always used lead.

Butte, Montana. Use cement for repairing leaks only.

Chester, Pa. Our leakage per mile of mains is less than I have been able to figure it in any previous works that I was ever connected with, and there has been a decided decrease in leakage since using cement joints.

Cincinnati, O. Do not use cement.

Cleveland, O. Do not use cement.

Dallas, Texas. Have not been using cement long enough to answer.

Danbury, Conn. This company has laid cement joints since 1857. A small amount of this old pipe is still in use. Of all the joints that we have uncovered, I think we have found but two joints that leaked and they were small leaks. A number of years ago the engineer in charge commenced the use of lead. Our experience is that the lead joints that were tight when they were laid were found to leak after a few years. We have abandoned the use of lead and gone back to cement.

Denver, Colo. (?)

Derby, Conn. There has been no preceptible change in the leakage due to cement joints.

Des Moines, Iowa. The leakage during the past 20 years has decreased until it is now at practically the minimum limit that can be obtained with ordinary care and good workmanship. We

have practically no complaints from leaky mains, and where we do have such complaints they are generally found to be the result of a break, due to the settlement of the ground or some lead joint.

Fall River, Mass. This question I cannot answer, as our joints have been practically all laid with cement, except on the pipe that was laid for two or three years before I came to Fall River. During that time lead was used almost exclusively, and it was on these lead joints that I found the greatest leakage when I first came to the city.

Grand Rapids, Mich. Leaks in street mains have decreased since we began this practice.

Houston, Texas. Decreased.

Jackson, Miss. Do not use cement.

Louisville, Ky. Do not use cement.

Lowell, Mass. Excerpts from report of Board of Gas Commissioners of the State of Massachusetts, 1898, 6.72%; 1899, 6.80%; 1900, 4.21%; 1901, 4.50%; 1902, 4.70%; 1903, 8.05%; the increase for 1903, which I attribute largely to the use of Texas oil in water gas manufacture.

Memphis, Tenn. Use lead exclusively.

Milwaukee, Wis. Do not use cement.

Mt. Vernon, N. Y. Since using cement joints we have cut leakage in half. All leakage is practically in old lead joints.

New Orleans, La. We have reason to believe that the leaks in street mains have diminished since the advent of the cement joint, and in fact we have never found but one leak which was actually in the joint and in that case we believe that the pipe was disturbed before the joint had set.

New York City. Do not use cement.

Paterson, N. J. Leakage has decreased since the use of cement joints began.

Peoria, Ill. Do not use cement.

Philadelphia, Pa. Norris. The use of cement joints has largely decreased the number of leaks in our gas mains.

Forstall. So far the total number of leaks that have developed in this amount of pipe (120 miles) laid with cement joints has been confined to 30 joints—an entirely insignificant number and very much less than the number of leaks we would have had if the pipe had been laid with lead joints.

Pittsburg, Pa. We do not know anything about lead joints, only that the natural gas companies of this city used lead for joining their mains and they had to dig down and recaulk them

about every two years until they got Dresser sleeves and put over them to keep them from leaking.

Portland, Maine. Cement is not used for joints in this city, but the Engineer in charge has had experience with other companies, which has thoroughly convinced him that cement joints are far superior to lead. As a matter of fact, when he took charge of this company the unaccounted for gas exceeded 16%, a fact which in itself was hardly favorable for the use of lead for street main joints. I really believe that there are ten joint leaks with lead to one where cement joints are used.

Reading, Pa. We have found less leaks in joints made with cement than those made with lead.

Richmond, Va. Do not use cement.

Rochester, N. Y. Decreased.

St. Augustine, Fla. We have been making cement joints for several years and have had no trouble whatever, except in cases where the joint was not properly made when the main was laid.

St. Paul, Minn. Do not use cement.

San Francisco, Cal. Do not use cement on account of instability of the ground.

Savannah, Ga. We have found no leaks in cement joints since we began using them.

Scranton, Pa. Just commenced the use of cement this year. About a month after completing the lines laid with cement we tested them carefully with a test-meter and found them absolutely tight, except a few leaks in the first two blocks laid, where the men had evidently not yet learned the knack of handling the cement.

Stapleton, N. Y. Our leakage has been decreased about one-half since our obtainiug possession.

Stockton, Cal. Do not use cement.

Waterbury, Conn. Leaks have decreased decidedly. As a matter of fact, I have not had a leak occur in a properly laid main with cement joints, neither a leak in the joint itself or a broken main.

Question No. 4—Have any really serious leaks occurred on a cement joint when the work was properly done?

Atlanta, Ga. No.

Baltimore, Md. No serious leaks have occurred on any of our cement joints.

Boston, Mass. Boston Gas Light Co. A leak in cement joints is very rare. The pipe will generally break rather than start a leaky joint.

Dorchester Gas Light Co. No.

Bridgeport, Conn. No.

Brooklyn, N. Y. Do not use cement.

Butte, Montana. Have not used cement for laying mains.

Chester, Pa. Of the pipe put down five years ago in Darby, there has never been a joint dug up for repair or one piece of main barred through complaint of leak. Whenever a main is uncovered for running service the ground is as sweet as the day the main was laid.

Cincinnati, O. Do not use cement.

Cleveland, O. Do not use cement.

Dallas, Texas. Have not used cement.

Danbury, Conn. Have found no leaks.

Denver, Colo. Use lead.

Derby, Conn. We have had no serious leaks on cement joints.

Des Moines, Iowa. I have never seen but three or four cement joints in my life which leaked, and I have uncovered a great many joints, both lead and cement; probably 20,000 in the last eight or ten years. We have had no trouble here from leaking cement joints since I have been here.

Fall River, Mass. I do not believe that a really serious leak is possible with a cement joint, when the work is properly done, as the joint seems to be as strong as the pipe, with the result that the pipe will break before the joint will give way.

Grand Rapids, Mich. No leaks have occurred when the joint is properly made.

Houston, Texas. No.

Jackson, Miss. Do not use cement.

Louisville, Ky. Do not use cement.

Lowell, Mass. No.

Memphis, Tenn. Do not use cement.

Milwaukee, Wis. Do not use cement.

Mt. Vernon, N. Y. Where a cement joint is made properly we have had no leaks whatever. Have only found leaks in twenty cement joints, all of which were improperly made and were caught before the ditches was filled.

New Orleans, La. We have never had any serious leaks occur on a cement joint, and have found any number of instances where our pipe, as at the present time is being disturbed by the sewer system which is being installed, that the main has broken close up to the joint and the cement joint remains perfectly intact and undisturbed.

New York City. Do not use cement.

Paterson, N. J. We seldom find a really serious leak in a cement joint.

Peoria, Ill. Do not use cement.

Philadelphia, Pa. Norris. The only serious leaks which have occurred where cement joints have been used have been cases of broken mains. I can recall no serious leak in a properly made cement joint.

Forstall. None of the thirty leaks spoken of have been large and our experience is that, except on small pipe such as four-inch and six-inch, leaks, when they occur in a cement-made line, are due to a very slight change in position between the two pipes joined together, causing a very fine crack in the cement and only allowing a little gas to escape.

Pittsburg, Pa. No serious leaks have occurred in a cement joint; all of the serious leaks we have had have been from broken mains.

Portland, Me. Do not use cement.

Reading, Pa. No.

Richmond, Va. Do not use cement.

Rochester, N. Y. No.

St. Augustine, Fla. No.

St. Paul, Minn. Do not use cement.

San Francisco, Cal. Do not use cement.

Savannah, Ga. Have had no leaks since we began using cement.

Scranton, Pa. No.

Stapleton, N. Y. There have been no serious leaks occur to cement joints where properly made cement was used and the work was properly done.

Stockton, Cal. Do not use cement.

Waterbury, Conn. Have not had a leak occur on a properly laid main with cement joints, either a leak in the joint or a broken main.

Question No. 5.—Is there any objection on the part of the city authorities to the use of cement for this purpose?

Atlanta, Ga. No.

Baltimore, Md. No.

Boston, Mass. Boston Gas Light Co. No.

Dorchester Gas Light Co. No.

Bridgeport, Conn. No.

Brooklyn, N. Y. Do not use.

Butte, Montana. Only use cement for repairing; apparently no objections.

Chester, Pa. No.

Cincinnati, O. Do not use.

Cleveland, O. Do not use.

Dallas, Texas. Have not used very much cement; apparently no objections.

Danbury, Conn. No.

Denver, Colo. Do not use cement.

Derby, Conn. No.

Des Moines, Iowa. No.

Fall River, Mass. I have met with no objection on the part of the city authorities to the use of cement for this purpose, and there certainly should be none, as it makes a safer joint than lead and reduces the leakage.

Grand Rapids, Mich. The city authorities not only do not object to our making the joints of cement, but they prefer that we should do so.

Houston, Texas. No.

Jackson, Miss. Do not use.

Louisville, Ky. Do not use.

Lowell, Mass. No.

Memphis, Tenn. Do not use.

Milwaukee, Wis. No.

Mt. Vernon, N. Y. Since explaining to the various city authorities the benefits of cement joints they prefer to have us use them.

New Orleans, La. There is no objection on the part of the city authorities to the use of cement joints.

New York City. Do not use.

Paterson, N. J. The city authorities have never raised any question about what we use in joints.

Peoria, Ill. Have never used cement.

Philadelphia, Pa. Norris. We have never heard of any objection on the part of the city authorities to the use of cement for this purpose.

Forstall. There has never been any objections on the part of the city authorities to the use of cement in the joints of our pipe.

Pittsburg, Pa. We have had no objections from the city authorities about using cement for joints.

Portland, Me. Do not use cement.

Reading, Pa. No.

Richmond, Va. Do not use.

Rochester, N. Y. No.

St. Augustine, Fla. No.

St. Paul, Minn. Do not use.

San Francisco, Cal. There is no objection on the part of the city authorities to the use of cement.

Savannah, Ga. No.

Scranton, Pa. No.

Stapleton, N. Y. There is absolutely no objection by the city authorities of New York to us using cement joints.

Stockton, Cal. Do not use cement.

Waterbury, Conn. Our city authorities do not object to cement joints.

Question No. 6.—Do you make any provision for expansion?

Atlanta, Ga. We put in one lead joint about every 200 feet and make all special lead joints. Sixteen-inch pipe and above we do not cement, but make lead joints.

Baltimore, Md. No.

Boston, Mass. Boston Gas Light Co. By the use of an occasional lead joint.

Dorchester Gas Light Co. The inserting of one lead joint in three may be considered partly as a provision for expansion. It also tends to make a line of small mains more elastic to provide for any settling of the main.

Bridgeport, Conn. No, only where the pipe comes out of the ground to cross a bridge or depression in roadway. Here we use an expansion joint.

Brooklyn, N. Y. Do not use cement.

Butte, Montana. Cement only used for repairing.

Chester, Pa. As the coefficient of expansion of cement is practically the same as iron, which is not true of lead, we do not provide for expansion, laying the mains deep enough so that the change of temperature is not enough to affect the pipe. As a matter of fact we consider the joints the strongest part of the main.

Cincinnati, O. Do not use.

Cleveland, O. Do not use cement.

Dallas, Texas, (Did not answer.)

Danbury, Conn. The only provision for expansion is at branch connections. The joint on the branch and on the first length of pipe in each direction are made with lead. In crossing bridges we use lead on the bridge and one or two lengths at each end. If the pipe is laid with the minimum cover of four feet, should expect the cement joints to remain tight whatever happened.

Denver, Colo. Use lead.

Derby, Conn. We make almost no provision for expansion.

Des Moines, Iowa. We did at one time make provision for expansion by inserting lead joints at various intervals, from as frequent intervals as from every other joint up to one joint in every block, and we have used lead joints in specials at the intersection of streets. This practice has been discontinued for some time and we are using cement joints exclusively.

Fall River, Mass. We do make provision for expansion by making every fifth joint with lead. Although we have been doing this for quite a number of years, I am much inclined to question its value and doubt if it is of any practical use.

Grand Rapids, Mich. We make no provision for expansion.

Houston, Texas. No.

Jackson, Miss. Do not use cement.

Louisville, Ky. Do not use cement.

Lowell, Mass. No.

Memphis, Tenn. Do not use cement.

Milwaukee, Wis. Do not use cement.

Mt. Vernon, N. Y. A pipe having four feet of covering does not need any provision for expansion. We use three feet of covering and no provision for expansion.

New Orleans, La. We make no provision for expansion as in this climate where there is so much water in the ground and our pipes are buried to a depth of about four feet, the variation in temperature is so slight that no such provision seems to be necessary.

New York City. Do not use cement.

Paterson, N. J. We use a lead joint every ten to fifteen lengths.

Peoria, Ill. Do not use cement.

Philadelphia, Pa. Norris. We sometimes make provision for expansion by inserting an occasional lead joint, but are rapidly abandoning this practice, as it has proven unnecessary.

Forstall. We do not make any provision for expansion. Our reason for taking this step is as follows: (I quote from an answer to a question in the Question Box of the Ohio Gas Light Association of 1904, Question No. 107.) "Of this the size 12-inch and under were laid using lead joints at street intersections only, except a small amount which was laid with every eighth joint lead. In 1902, 5,500 feet of 16-inch, 4,500 feet of 20-inch and 4,000 feet of 30-inch were laid with lead every eighth joint, except for one stretch of 3,400 feet of 20-inch, where lead was

used only at intersections. A comparison of the distance apart of two marked points on either side of a lead joint in the 30-inch line, as between August and January, showed that the total movement could be accounted for by the contraction in only twenty-four feet of pipe, and therefore if a lead joint was needed at all it ought to occur every second joint. However, as no leaks developed on the 20-inch main laid with lead joints only at intersections, it was decided that lead could be dispensed with, and 1903, 8,000 feet of 30-inch, 1,200 feet of 20-inch and 2,900 feet of 16-inch was laid with all cement joints. Up to present writing not a leak has developed on this work, and the leaks found on the small pipe have been few in number. Therefore, our answer is that no lead joints need be used with cement."

Pittsburgh, Pa. In recent years we have been making a lead joint every 300 or 400 feet, but cannot say whether that prevents the pipe from breaking or not.

Portland, Me. (Did not answer.)

Reading, Pa. In four and six-inch pipe we put about two lead joints to one block; pipe of larger size we do not make such provisions.

Richmond, Va. Do not use cement.

Rochester, N. Y. We put in a lead sleeve every fifth to tenth length according to the soil and contour of the ground.

St. Augustine, Fla. (Did not answer.)

St. Paul, Minn. Do not use cement.

San Francisco, Cal. We make no provision for expansion, as the variation in our temperature is so slight.

Savannah, Ga. On large mains every fourth or fifth joint is of lead; on small ones every eighth or tenth.

Scranton, Pa. (Did not answer.)

Stapleton, N. Y. We set every special with lead joints and if the blocks run up to 1,000 feet we put a lead joint in the middle of the block.

Stockton, Cal. Do not use cement.

Waterbury, Conn. No provision is made for expansion ordinarily, as it does not occur ordinarily.

Question No. 7.—In your judgment, assuming that pipes are laid with the minimum cover of four feet and joints properly made with cement, do you think the chances for a leak would be increased or decreased over what they would be had the joints been laid with lead?

Atlanta, Ga. Less chance of leakage with cement.

Baltimore, Md. We have reasons to believe that the leaks will decrease where cement is used.

Boston, Mass. Boston Gas Light Co. Decreased.

Dorchester Gas Light Co. In our experience the cement joints are the tightest joints and would be used entirely where the mains are laid in solid soil and there was no probability of the pipes being undermined by sewer or other excavations.

Bridgeport, Conn. When this company took charge of the opposition company, we went over their street mains very thoroughly and had to virtually dig up every joint. The majority showed that the lead had shoved out when pipes had expanded and never went fully back when the pipes contracted. The grooves in the lead allowed the gas to leak out and this rotted the packing. The result was that we had a very bad leak in nearly every case where this occurred. With cement joints I have found that a joint is very seldom pulled out by expansion, and if it is, ninety-nine times out of a hundred the joint has been improperly made.

Brooklyn, N. Y. Do not use cement.

Butte, Montana. Do not use, except for repairs.

Chester, Pa. I believe that the chances of leaks in pipe laid with four feet of cover, when cement is used, are much decreased over the use of lead.

Cincinnati, O. Do not use.

Cleveland, O. Do not use.

Dallas, Texas. Do not use.

Danbury, Conn. If the pipe is laid with four feet of cover, should expect the cement joints to remain tight whatever happened.

Derby, Conn. In our judgment, we cannot improve on well-made cement joints.

Denver, Colo. Use lead.

Des Moines, Iowa. The expansion and contraction of the pipes, due to changes in temperature at the depth of 4 feet is so slight and so uniform that I do not believe that it can possibly affect cement joints when properly made. The only other cause for leaks would be the settlement of the pipes, and if the pipe is properly laid in the first place, there should be no settlement. At the same time, a line of mains laid with cement joints is more flexible during the construction than lead joints, because the lead joints in being driven up are apt to place the pipe under tension and then when the filling occurs every time the pipe will assume a new position with the consequent strain of the joints

and leakage thereform. In making up the cement joints there is not this tension, as the pipe is perfectly flexible until after the workmen have left the joint and the cement has had time to set and the pipe is, therefore, enabled to assume a more natural position.

Fall River, Mass. With any amount of cover I should much prefer a properly made cement joint to one made of lead, unless in very soft ground or where you must provide for settlement of the pipe; in such case I believe a cement joint is too rigid to be used successfully. As an indication of a system made with practically all cement joints, I would say that our leakage for some years past has been under 1%, excepting for a recent period of a few months, when it increased to about 6%, owing to a leaky holder.

Grand Rapids, Mich. The chances for leakage would be decreased by the use of cement.

Houston, Texas. A lead joint will leak sometimes; a properly made cement joint can never leak.

Jackson, Miss. Do not use.

Louisville, Ky. Use lead.

Lowell, Mass. The chances for leaks are increased by the use of lead in making joints.

Memphis, Tenn. Do not use.

Milwaukee, Wis. Do not use.

Mt. Vernon, N. Y. The chances for a leak with cement joints are decreased one thousand fold over a joint laid with lead.

New Orleans, La. I believe there will be no chance for increased leakage where proper cement joint is used. My observation on old cement joints I found here is that the cement becomes incorporated with the iron in such a way that it is practically the same as though it was solid metal instead of cement joint.

New York City. Do not use.

Paterson, N. J. We consider cement joints tighter than lead joints.

Peoria, Ill. Do not use.

Philadelphia, Pa. Norris. Under the conditions you mention, the chances for the development of leaks are much decreased when cement joints are used instead of lead.

Forstall. Under the conditions stated, I would much prefer using cement than lead, believing that the chances for leakage would be greatly increased by the use of lead as compared with the use of cement.

Pittsburg, Pa. A cement joint properly made, if the bell is

4½ or 5 inches deep, will not leak if it gets time to set properly, but they may cause more broken mains than lead joints will. But my experience has been that it is much easier to locate a large leak than a great number of small ones, and requires less digging up of the streets to repair it.

Portland, Me. Consideration of public health, also, strongly dictate that the joints should be made with cement for the reason that it is infinitely better to have one good size leak and find it and stop it, than to have an innumerable number of small ones.

Reading, Pa. We shall never use anything else but cement for joints, because we consider it a very much better material than lead. There can be no doubt that the pipe well laid and with cement joints properly made, the leakage account would be very much decreased below that of well-laid pipe with lead joints.

Richmond, Va. Do not use.

Rochester, N. Y. Decreased.

St. Augustine, Fla. Did not answer.

St. Paul, Minn. Do not use cement.

San Francisco, Cal. It would seem to me that the chances for a leak would not be increased any if joints were made of cement, and expansion taken care of and no settlement in the ground.

Savannah, Ga. There is no doubt in my mind but that the chances for a leak would be greatly increased if the joints were made of lead.

Scranton, Pa. Did not answer.

Stapleton, N. Y. In my judgment, assuming that the pipes are laid with the minimum cover of four feet and joints properly made with cement, I think the chances for a leak would be greatly decreased over what they would be had the joints been made with lead.

Stockton, Cal. Do not use.

Waterbury, Conn. A properly made joint of lead is as durable and good as one made of cement, and should last equally well under favorable conditions. The cost being in favor of the cement, and the chances of poor work are less with cement than with lead, I think, because the ordinary man is more likely to get his joint filled thoroughly.

Question No. 8. What brand of cement do you use?

Atlanta, Ga. Dyckerhoff Portland Cement.

Baltimore, Md. Booneville Portland Cement.

Boston, Mass. Boston Gas Light Co. Portland Cement.

Dorchester Gas Light Co. Any good brand of Portland Cement. In cold weather we use a quick setting cement and in warm weather a slower setting cement is better.

Bridgeport, Conn. The best Portland—imported and American.

Brooklyn, N. Y. Do not use.

Butte, Montana. (Did not answer.)

Chester, Pa. We use an imported brand of Mannheimer Cement.

Cincinnati, O. Do not use.

Cleveland, O. Do not use.

Danbury, Conn. We use Atlas Portland cement and Mannheimer Portland cement. Have used other brands; would not hesitate to use any good Portland cement.

Dallas, Texas. (Did not answer.)

Denver, Colo. Use lead.

Derby, Conn. We use Alpha cement.

Des Moines, Iowa. We use Alsen Portland cement or some equally quick-setting Portland cement of first quality, and our joints are made with neat cement and untarred yarn.

Fall River, Mass. We use almost exclusively the Orchard brand of Roman cement. There have been times when we have been unable to obtain this, when we used the Calderwood brand but we much prefer the Orchard because of its greater speed in setting.

Grand Rapids, Mich. We have used Alsen and American Portland cements. We are now using the latter. Some companies use ordinary Louisville cement with perfectly satisfactory results.

Houston, Texas. Alsen when it can be had. I have used Alpha, Atlas and Vulcanite with satisfactory results.

Jackson, Miss. Do not use.

Louisville, Ky. Do not use.

Lowell, Mass. Use Atlas Portland without sand.

Memphis, Tenn. Do not use.

Milwaukee, Wis. Do not use.

Mt. Vernon, N. Y. We use German Dyckerhoff Portland cement.

New Orleans, La. We use Dyckerhoff Portland cement in making our joints.

New York City. Do not use.

Paterson, N. J. Dyckerhoff cement.

Peoria, Ill. Do not use cement.

Philadelphia, Pa. Norris. Any good brand of Portland cement. We formerly used, generally, the Dyckerhoff brand, but of late years have found some of the American Portland cements better adapted for our purpose.

Forstall. We formerly used the Dyckerhoff brand of German Portland, but beginning with 1903 we have used the Star brand, an American Portland. In the tests we made at the time of making the change, there was very little to choose from as between the Star and several other well-known brands of American cement.

Pittsburg, Pa. We use the Hoffman brand of Rosendale cement. It is not a quick-setting cement and that gives time for making the joint properly.

Portland, Me. (Did not answer.)

Reading, Pa. We use a good Portland cement. We consider any good Portland cement will answer the purpose.

Richmond, Va. Do not use.

Rochester, N. Y. Any standard brand of Portland cement will make good joints. The secret is in mixing, taking care not to use too much water.

St. Augustine, Fla. (Did not answer.)

St. Paul, Minn. Do not use.

San Francisco, Cal. (Did not answer.)

Savannah, Ga. We have no special brand of cement we use I prefer a good Portland cement that sets up well and fairly quick.

Scranton, Pa. (Did not answer.)

Stapleton, N. Y. We use Dyckerhoff and Mannheimer cement.

Stockton, Cal. Do not use.

Waterbury, Conn. I use Mannheimer Portland cement altogether, for these reasons: It sets up in about the right time, neither too fast nor too slowly. It runs uniformly, does not vary in quality or firmness, and makes a hard, durable joint.

REMARKS.

Atlanta, Ga.

Baltimore, Md.

Boston, Mass. Boston Gas Light Co. In conclusion, I would say that my experience confirms the belief that under favorable conditions a system laid with cement joints, properly made, will show less leakage and require less care than one made with lead joints exclusively.

Dorchester Gas Light Co. In conclusion, I would repeat that a well-made cement joint is the tightest joint for gas mains—its only fault is that it is less flexible than a lead joint and a small main is more liable to break when laid with cement in place of lead joints. This trouble will occur principally in newly filled streets or where the streets

are built over marsh mud, or when the other excavations in the street undermine the foundations of the mains. Unless these conditions are the rule, I think it would be a mistake to abandon the use of cement. The unaccounted for gas, which includes the leakage, has not averaged over 3 per cent. for the past six years in this company.

Bridgeport, Conn. In this city, where we have had opposition who have had lead joints and this company who used cement joints only, the percentage of loss was greatly in our favor, viz: Nine per cent. to 31 per cent.

Brooklyn, N. Y.

Butte, Montana. Should we lay any large pipe in the future, we will undoubtedly use cement for joints. We would recommend cement in all cases.

Chester, Pa. I believe that by the use of cement for joints electrolysis is considerably decreased, and I further believe that a management laying lead joints to-day is throwing away its stockholders' money in leakage account, which would run up to enormous figures in the course of a few years. It is not unusual to find companies in quite large cities with leakage of 20 per cent., which, undoubtedly, is due very largely to lead joints.

Cincinnati, O.

Cleveland, O. The fact that our attempt to use cement for joints was a failure has not prejudiced us against its use, if properly prepared and used; for we know that the work was not properly done.

Dallas, Texas. I expect in the near future to have the bulk of our joints made with cement. You should have no difficulty in persuading local authorities to grant you making cement joints, as you are doubtless on the right track, providing the joints are made with care.

Danbury, Conn.

Denver, Colo.

Derby, Conn.

Des Moines, Iowa. In my judgment, it requires more skill to make up a good lead joint than it does to make up a good cement joint, as there are more opportunities for a flaw in the workmanship, and if the lead is poured too hot, which is more likely to occur than too cold, it is apt to scorch the yarn and dry it out, leaving it loose, and in cement this cannot occur, because the yarn being thoroughly impregnated with cement and driven home in the joint, assumes perfectly the form of the interior of the bell and the exterior of the spigot, and as the cement sets, it must retain its position indefinitely.

Fall River, Mass.

Grand Rapids, Mich.

Houston, Texas. For my views and practice I refer you to page 152 of the last "Ohio Question Box." Our leakage was never so small as at present.

Jackson, Miss.

Louisville, Ky.

Lowell, Mass. The percentage of loss given is the difference between the register of the station meter and consumers' meters, and includes loss from every source. Should you desire, I will send you a joint of a pipe made of cement that has been in use for thirty years and removed to increase the size.

Memphis, Tenn.

Milwaukee, Wis.

Mt. Vernon, N. Y. For a number of years I was an enthusiastic "Lead Joint Man," because I personally supervised the work and knew the work we were doing was better lead joint work than the lead joint work done by others. Since making cement joints, (and my experience with them has covered a period of ten years) I will say, in no case and under no circumstances will I make another lead joint. A lead joint will leak any time, or when conditions favor starting a leak. A cement joint is stronger than the pipe itself, and, if properly made, is absolutely tight. I am now having tested some 50 jobs of cement joints, gas main extensions, each of which cover about 1,000 feet of pipe laid in 1900. I am having the consumers cut off, at the meter cock, the main cut off and tested with a meter with full gas pressure, and am particularly pleased to say that out of the twelve jobs tested last month, each and every one was absolutely tight. So no more lead joints for me.

New Orleans, La. I am surprised at the city authorities objecting to cement joints, and were I in some other cities where I am well acquainted with municipal affairs I might think that the street railway company was influencing that legislation, finding that cement joints do not offer very good facilities for returning currents on gas pipes.

New York City.

Paterson, N. J.

Peoria, Ill.

Philadelphia, Pa. Norris. The U. G. I. has almost, if not quite, abandoned the use of lead joints for the smaller sizes of mains, except in the business sections of larger cities, where the mains are liable to be constantly disturbed by other sub-surface structures. We believe the cement joints give a much more reliable and tight job than the lead joints, and where the cement joints are properly made, the joint is stronger than the pipe. Mains laid with cement joints are somewhat more liable to an actual fracture of the main, but are much less liable to develop a

series of small leaks distributed along the main. With 4 ft. of cover, breaks in the main should be of very rare occurrence indeed, and the necessity for disturbing the paving on account of leaks would be very much greater with the lead joints than with cement. In regard to the use of occasional lead joints to take care of expansion, a few of our Works are using occasional lead joints for this purpose, but our experience in places where we used nothing but lead joints, indicates that the lead joint is of no advantage whatever, and consequently I would not hesitate to make nothing but cement joints.

Forstall.

Pittsburg, Pa.

Portland, Me. Many years experience with other companies where cement joints were wholly used has convinced me that cement joints are far superior to lead. As a matter of fact, when I took charge of this Company, the unaccounted for gas exceeded 16%, a fact which in itself was hardly favorable for the use of lead for street main joints. It seems to me that when your city authorities are in possession of all the facts that they will unquestionably decide that your practice of making cement joints is far better for all concerned than it would be were you required to make lead joints.

Reading, Pa.

Richmond, Va.

Rochester, N. Y. I believe that cement joints, properly made, are superior to lead in every way.

St. Augustine, Fla.

St. Paul, Minn.

San Francisco, Cal.

Savannah, Ga. Replying to same, must say that I regret to learn that your "City Fathers" are not keeping abreast with the times, as every Gas Engineer and Manager knows the superiority of a cement joint over one of lead, and I am surprised to know that your city officials are so up-to-date in so many respects and so behind the times in this one.

Scranton, Pa.

Stapleton, N. Y. In connection with this matter, I would say that while I was connected with the Niagara Falls (N. Y.) Company, we acquired control over the Niagara Falls (Ontario) Company and I was called upon to lay pipe in that place. The authorities at first objected, but, when shown a few joints and how they were made, gave up their opposition.

Stockton, Cal.

Waterbury, Conn. My practice in laying mains is to use cement on all new lines. On repair work, old mains or on

emergency work I use lead for convenience and speed. On new work I try to let the cement set up about six hours, when the joints will stand our testing pressure of ten pounds, each joint being tested with soap suds.

Question No. 1.—To what extent are you using cement in the laying of gas mains in your city?

Binghamton, N. Y. Use lead for laying mains; cement used in joints around the works only.

Brooklyn, N. Y. Kings County Lighting Co. Have never used cement.

Camden, N. J. I am using cement joints on all low pressure gas mains laid in the South Jersey Division, including Trenton and Camden and all the small towns in the neighborhood.

Chicago, Ill. Do not use very much cement. Have a record of a 16-inch main being laid in 1862, with cement joints, and so far as I am able to find out, we have had no trouble with leaking joints

Colorado Springs, Colo. Do not use cement in laying mains. Have some cement joints in the purifying house, which have been in for fifteen years and are in perfect condition today,

Columbus, O. We are not laying any mains at present since introduction of natural gas. When we were laying mains, however, we used cement joints. We have always done so.

San Francisco, Cal.

Question No. 2.—For how many years have you been using cement?

Binghamton, N. Y. Do not use cement.

Brooklyn, N. Y. Kings County Lighting Co. Do not use cement.

Camden, N. J. I have now had six years' experience in the use of cement joints.

Chicago, Ill. Do not use cement at the present time, but have a main laid since 1862, with cement joints, and have had no trouble.

Colorado Springs, Colo. Cement not used for joints in mains. It has been in use for fifteen years in the works.

Columbus, O. Always used cement.

San Francisco, Cal.

Question No. 3.—Have leaks in the gas mains increased or decreased since you started to use cement for joints instead of lead.

Binghamton, N. Y. Do not use cement.

Brooklyn, N. Y. Kings County Lighting Co. Do not use cement.

Camden, N. J. The leaks in joints of gas mains, when using cement joints, are far less frequent than when using lead joints.

Chicago, Ill. Have not used cement excepting on one line laid in 1862, and we have no trouble on this.

Colorado Springs, Colo. Do not use cement in laying mains.

Columbus, O. Always used cement.

San Francisco, Cal.

Question No. 4.—Have any really serious leaks occurred in a cement joint when the work was properly done?

Binghamton, N. Y. Do not use cement.

Brooklyn, N. Y. Kings County Lighting Co. Do not use cement.

Camden, N. J. (Did not answer.)

Chicago, Ill. No.

Colorado Springs, Colo. Do not use cement on main work.

Columbus, O. We have had no serious leaks on account of cement joints.

San Francisco, Cal.

Question No 5.—Is there any objection on the part of the city authorities to the use of cement for this purpose?

Binghamton, N. Y. Do not use cement.

Brooklyn, N. Y. Kings County Lighting Co. Do not use cement.

Camden, N. J. There is no objection on the part of the city authorities, in any town in which I have worked, to using cement joints.

Chicago, Ill. Does not answer, but apparently no objection as they have one line laid with cement.

Colorado Springs, Colo. Do not use cement.

Columbus, O. There is no objection whatever on the part of the city authorities to the use of cement joints.

San Francisco, Cal.

Question No. 6.—Do you make any provisions for expansion?

Binghamton, N. Y. Do not use cement.

Brooklyn, N. Y. Kings County Lighing Co. Do not use cement.

Camden, N. J. I do not make any provision for expansion, as my experience has proven it unnecessary.

Chicago, Ill. Do not answer.

Colorado Springs, Colo. Do not use cement for main work.

Columbus, O. Use lead every fifth joint on 24-inch line.

San Francisco, Cal.

Question No. 7.—In your judgment, assuming that pipes are laid with the minimum cover of four feet and joints properly made with cement, do you think the chances for a leak would be increased or decreased over what they would be had the joints been laid with lead?

Binghamton, N. Y., Do not use cement.

Brooklyn, N. Y. Kings County Lighting Co. Do not use cement.

Camden, N. J. In my judgment, properly laid cement joints are far safer and more free from leakage than the best made lead joints.

Chicago, Ill. Do not answer.

Colorado Springs, Colo. Do not use cement on main work.

Columbus, O. Do not answer, but apparently of the opinion that cement joints are best, as they have always used them.

San Francisco, Cal.

Question No. 8.—What brand of cement do you use?

Binghamton, N. Y. Do not use cement.

Brooklyn, N. Y. Kings County Lighting Co. Do not use cement.

Camden, N. J. Dyckerhoff cement.

Chicago, Ill. Did not answer.

Colorado Springs, Colo. Do not use cement on main work.

Columbus, O. Use American hydraulic brand of cement.

San Francisco, Cal.

REMARKS.

Binghamton, N. Y.

Brooklyn, N. Y.

Camden, N. J. In six years' experience I have had I have never dug up a leaking cement joint, with the exception of the first main I laid in Frankfort, about six years ago, on which it it was necessary to dig up four joints within a day after they

were laid, but I am certain that this was due to the fact that neither I nor my men knew how to make the joints. It has been my experience, as in the case of a broken main, which is the only leak I have had any experience with, when using cement joints, the break occurs somewhere in the iron pipe than in the cement joint, apparently showing that the cement joint is stronger and harder than the iron itself.

With regard to leaks of gas in street, would say that it is generally far less dangerous to have one big leak, which can be promptly traced, than a number of small leaks in points which are more difficult to locate.

Chicago, Ill.

Colorado Springs, Colo.

Columbus, O.

San Francisco, Cal. I have your letter of inquiry of Sept. 1st, and beg to reply that I have always been a firm believer in, and a strong advocate of cement joints for cast iron gas mains. While connected with the Boston Company, I used nothing but cement joints with the single exception of lead joints at the valves at street intersections. It has been my experience with the use of cement joints in ground subject to frosts, that the joint, if properly made, is stronger than any portion of the pipe, and I have often times had "breaks" back of the bell without the joint in any way being disturbed.

In California, nothing but lead joints are used. This is a continuance of an old custom adopted in early days, and our mains are shallow, never subject to unequal expansion and contraction due to freezing, and withal we have much trouble from earthquakes, and lead joints seem to stand the rapid undulation of the earth due to earthquakes. However, the peculiar conditions existing on the Pacific Coast should not in any way affect the continued use of cement joints in the Middle and Eastern States.

In answer to the various questions, I have been using cement joints, personally, for twenty-eight years. Leakage of gas mains is much less where cement joints are used than where lead is used, because the cement joint is rigid, and if there is a leak at all, it is a broken pipe which is easily found and remedied; whereas lead joints nearly all leak on account of the difference of the coefficient of expansion between lead and iron, and these leaks, though small in themselves, in the aggregate amount to a large loss of gas.

I have never known of any objections on the part of the city authorities to the use of cement for making joints. The provision made for expansion has been, as stated above, by the use of lead joints at the valves at street intersections.

In answer to your question No. 7, in my judgment, I believe

pipes laid with cement joints would have less chance of leaking than those laid with lead, and I also believe in laying pipes as shallow as possible, so that it may remain in the frost during the winter, as the frost comes out of the ground from the bottom instead of the top, thus causing a heavy strain on the pipe each time there is a thaw; while pipe which is frozen in the ground early in the season, and remains frozen during the winter, is almost proof against breaks.

The brand of cement, which I used in Boston, was half Rosendale and half English Portland, mixed with sharp sand. If you care to, I would like to have you read a paper on the subject of "Leakage," which I read before the American Gas Light Association at Baltimore, in 1889. This outlines my method of handling street mains in Boston, and is as true to-day as it was when it was written. You will find this paper on page 43 of volume 9, of the Proceedings of the American Gas Light Association.

Portland, Oregon. Portland Gas Company.

First. We are not now using cement for making joints in our street mains. We have used it in the past to the following extent:

5,000	joints	4	-inch	pipe.
2,400	"	6	"	"
2,260	"	8	"	"
870	"	10	"	"

Second. We have been using cement for about five years but stopped using it last fall.

Third. There has been no noticable difference in the leakage.

Fourth. We have never found any serious leaks in the cement joints if it was properly done.

Fifth. No.

Sixth. Yes; we provide for expansion by making lead joints every 260 feet (length of a block,) and all fittings are run with lead.

Seventh. With cement joints very few small leaks show up. We have had no trouble with broken mains. On the whole I think there is more chance for a leak in a lead joint than there is with a cement joint. In my opinion the question of leakage has much more to do with the services than it has with the mains.

Eighth. Alsen, Teutonia and Germania.

In general I would make these comments: In case of leak a cement joint is difficult to repair. It is necessary to have absolutely dependable workmen when laying pipe with cement.

Pittsfield, Mass. Pittsfield Coal Gas Company.

First. Use cement joints exclusively.

Second. For past fifteen years.

Third. Never have used lead.

Fourth. No.

Fifth. No.

Sixth. Not usually.

Seventh. There is small chance of any leakage with cement joints. When a leak does occur it is generally a good sized one and easily located and repaired, while with lead joints they all leak a little but in amounts so small that they are hard to locate.

Eighth. Orchard Roman cement (a Scotch cement), also American Portland cement at times.

SUMMARY OF ANSWERS.

QUESTION NO. 1.

To what extent are you using cement in the laying of gas mains in your city?

Entirely	10
Almost entirely	19
For repairs to mains only	2
In Works only	1
Do not use cement	20
	52

QUESTION NO. 2.

For how many years have you been using cement?

One year	2
Three years	1
Five years	3
Six years	3
Seven years	1
Eight years	2
Ten years	3
Fifteen years	3
Twenty years	2
Twenty-five years	1
Thirty years	1
Forty years	1
Forty-seven years	1
Fifty years	1
Fifty-five years	1
Have always used cement	3
Did not answer	3
Do not use cement	20
	52

QUESTION NO. 3.

Have leaks in gas mains increased or decreased since you started to use cement for the joints instead of lead?

Decreased	19
Experience not long enough to answer	3
Have always used cement	6
No change	2
Used for repairing leaks only	1
Do not use cement	19
Never used lead	1
Did not answer	1
	52

QUESTION NO. 4.

Have any really serious leaks occurred on a cement joint when the work was properly done?

No	29
Seldom	1
Did not answer	2
Do not use cement	20
	52

QUESTION NO. 5.

Is there any objection on the part of the city authorities to the use of cement for this purpose?

No	35
Did not answer	1
Do not use cement	16
	52

QUESTION NO. 6.

Do you make any provision for expansion?

No	17
Yes	12
Did not answer	6
Do not use cement	17
	52

QUESTION NO. 7.

In your judgment, assuming that pipes are laid with the minimum cover of four feet and joints properly made with cement, do you think the chances for a leak would be increased or decreased over what they would be had the joints been laid with lead?

Decreased	29
Did not answer	5
Do not use cement	18
	52

QUESTION NO. 8.

What brand of cement do you use?

Dyckerhoff Portland	6
Bonneville Portland	1
Mannheimer Portland	2
Any kind of Portland	8
Atlas	2
Alpha	1
Alsen	3
Orchard brand Roman	2
Star	1
Hoffman brand Rosendale	1
American Hydraulic	1
Did not answer	9
Do not use cement	15
	52

DISCUSSION.

THE PRESIDENT—Mr. von Maur's paper is before you. I hope there will be free discussion.

MR. STEINWEDELL—I would like to ask whether the hubs in these cement joints were of any special diameter or special depth, or whether they were just the same hubs that would be used with lead.

THE SECRETARY—The following contribution to the discussion of the paper on "Cement Joints" has been received from Mr. Ralph Woodward, of Pittsfield, Mass.:

MR. WOODWARD—I do not feel that I can add much to the discussion on the subject of cement joints. The subject has been well threshed out by Mr. von Maur and his conclusions are most exhaustive. It would seem that the cement joint is the joint for gas companies to use. In my own experience I have been making almost exclusively cement joints for 20 years, and believe them to be the best possible joints for a gas company to make. Any good Portland cement may be used; but I have used with good success the Orchard Roman cement (an imported Scotch cement), for the reason that it is very quick setting and is not quite so hard and brittle when set as some made with American Portland cements. It is, however, so quick setting that during hot weather we have to mix a certain proportion of Portland cement with it to get the best results. I believe the

[illegible]

[illegible]

[illegible]

MR. DOTY—I would like to say that my experience rather coincides with that of Mr. Forstall, and my judgment somewhat goes the same way. I have felt that in business sections of the city where we are more liable to have disturbance, it is better to lay lead joints, for the reason that, while we may have a number of small leaks, they won't be so dangerous. A cement joint, to my mind, while it is a rigid and a tight one, is very liable to break the main in case of a disturbance in the street, and we are very apt to have from the breakage of the main a dangerous leak, which is liable to cause an explosion, whereas with the lead joint the leakage is not apt to be so very serious at the moment. Another point that occurs to me is on page 319. Mr. von Maur reports that referring to Mr. Brownell's test in his "Electrolytic Survey of the City of St. Louis:" "This test certainly shows that a cement joint has a great advantage over a lead joint from a purely electrolytic standpoint." I would like to ask Mr. von Maur how he sustains that position. I think it is generally recognized that cement is practically a non-conductor, and while lead is not a good conductor it is nevertheless a conductor. As I understand the theory of electrolysis, the danger to the pipe comes where the current leaves the pipe, and the introduction of any resistance will tend to drive the current from pipe, and it seems to me that, therefore, you will have the current leaving the pipe at every joint and carrying with it the iron and so destroying the pipe. With the lead joint you do not have this tendency to such an extent. Therefore, to my mind, and I believe it was the generally accepted opinion, the lead joint was a better joint to use to safeguard one to a certain extent—not wholly, but to a certain extent—against the dangers from electrolysis, and I thought that I had Mr. Brownell's own expressions in support of this. I recently received a copy of an electrolytic survey made by Mr. Brownell, for Mr. F. H. Shelton, of one of Mr. Shelton's companies in Pennsylvania, and Mr. Brownell in that report, as I read it, certainly gave his testimony in favor of using lead joints to minimize as much as possible the destruction of the pipe by electrolysis. I would like to have Mr. von Maur sustain his position on the cement joint as an advantage over the lead joint from purely an electric standpoint.

MR. T. D. MILLER—I think Mr. Doty has made a very serious error in his discussion of the cement joint and lead joint

as concerns preventing electrolysis. If every joint in a main is a cement joint, and the resistance of that cement joint is so high, the electricity will not go to the main with near the facility that it will when the joints are lead and are better conductors. The introduction of an occasional joint of high resistance would have a tendency in the ordinary run of the pipe to attract the current to the pipe for that run and then leave the pipe; but where you have practically non-conducting joints every 12 feet, the chances are that the current would not go to the pipe at all, because resistance along that pipe is much greater than the ground itself, or perhaps than the rail immediately in the vicinity. Now, my experience on electrolysis is that as soon as you create a little better conductivity in your main you get more current, and the bonding of the two rails to the points where the current leaves the pipe will have a tendency to make the pipe take more current out in the sections of the city where the current is going through the pipe. Wherever it strikes a joint of high resistance it will jump around and create damage there. Therefore, I believe that universally the use of cement joints will have a tendency to reduce electrolysis throughout the entire system of mains. The question of using cement joints in soft ground, as against using lead in preference, and because of the protection and elasticity of the lead joint, has been raised. We would be barred from using cement joints entirely in New Orleans if that were the case. The entire system of mains in that city is laid on 2-inch plank to act as a sort of float you might say to hold up the pipe. It is true that the tendency to break is greater, but where there is so much soft soil the foundations are so poor that there is usually a good deal of water. A bad break of a main where there is a good deal of water, or a break of any kind, unless there is a very high pressure, would have the tendency to let the water into the main instead of the gas out. That is one of the troubles that we have to contend with; it is not gas leaking out of our mains but water leaking in.

THE PRESIDENT—Mr. Miller says he uses cement joints exclusively in New Orleans. Does he have no lead joints; no expansion joints of any kind whatever?

MR. MILLER—We have a great many lead joints there. I think it was two or three years ago I had a very decided argument with Mr. Shelton on the train (Mr. Thwing and Mr.

Barret were there), and I argued in favor of the lead joint for soft ground. They bore me out in it. I have changed my mind. We are using cement joints entirely there. We are having a great deal of sewerage and conduit work going on there now, and it is a very common thing for us to have a block or two of main sink as a result of the excavation in the vicinity, cutting off our main from quite a section of the town by sinking of the main and the letting of the water in. Last month, while we had to raise about 7 or 8 blocks of main and regrade it, we had but 2 broken mains during the month.

MR. FULLERTON—In Schenectady, N. Y., we use cement joints exclusively. We don't allow for any expansion or contraction. We use 5-inch bells. Last summer we had occasion to lay about 1,600 feet of pipe, where we had to sheet pile the whole length of the ditch, and the bottom was very soft, in fact, kind of quicksand, We placed a 2-inch plank for blocking about 2 feet long under each end of pipe. That pipe gave us no trouble. The drip has not caused any more water. To stop the water from washing the cement off joint we tore the cement bags in two, doubled up the half of bag and filled it with dry cement and wound it around the joint and tied it there. Those joints gave no trouble since then. That is very nearly a year ago.

MR. DOTY—I would like to ask Mr. Fullerton what kind of joints he used in Buffalo?

MR. FULLERTON—Cement joints exclusively. I will say that for 3 years they have had no broken mains with cement joints in Schenectady. In Buffalo we had quite a few with lead joints.

THE PRESIDENT—Any further discussion on the topic? Is Mr. Searle in the room? Mr. Shattuck? Mr. McAdam?

MR. MCADAM—It is very evident from Mr. von Maur's figures that cement joints are cheaper than lead. It is a cheaper joint; but why should Mr. von Maur's figures for labor be shown in favor of cement? I contend that a lead joint can be made much quicker than a cement joint. I have done it; I have seen it done. Or is Mr. von Maur figuring his labor on the unskilled basis? If so, I think there is danger there, from the fact that those unskilled men may suddenly feel that they are skilled, after they have made joints for some time, and tell you so. The consequence is that they will demand just as much for

their labor as you pay the caulkers. That means trouble, and if they don't get more money they will certainly give you poorer work. A poor cement joint is worse than a poor lead joint. The difference in cost really ought to be in the lead. There again I believe Mr. von Maur could shave off some of the cost. Lead seems to me to be too high. In Milwaukee we use from 15 to 25 per cent. less lead than St. Louis does, and we have got no trouble from leaky joints, because they are well made. In the winter of 1904-5 nearly all of our main system was in frost. We had only 6 broken mains, 4 of which were caused by sewerage, 2 where the services were tapped into the mains, and only 1 of which was in the business district. At different points in Milwaukee, and within a radius of 600 feet, we had a difference in the depth of frost of nearly 2 feet. There is where your expansion and contraction come in. Now, I doubt if a cement joint could be used to any advantage in a condition such as that. I doubt it. I will say no. It is not expansion and contraction of a pipe that we have to contend with so much as in the ground. But still I don't believe that there is 1 out of 100 of us who pays any attention to expansion and contraction while having lead joints. We talk about it in papers and at the meetings, but that is about all the attention we pay to it. For instance, you go to lay a pipe and the pipe is laying on the edge of the trench. In the warm weather that line of pipe certainly receives all its expansion from the heat of the sun. But should you do that work in a busy district, where you must use all care and all haste to get the work completed, you naturally would flush a portion of the ditch. We do. And I am confident that if you uncover that whole stretch of pipe through a block, you would not find one of these lead joints leaking, provided you made the joint tight in the first place. Cement could never stand that. I believe that it is a case of locality, and when the condition is such as we have in Milwaukee, I don't believe it would be advisable to use cement joints.

THE PRESIDENT—Any further remarks, gentlemen, on this topic?

MR. HAINES—We have used cement joints in Des Moines for some 20 years, and I do not agree with the gentlemen who just spoke in regard to the labor conditions. I believe that any intelligent laborer can make a first-class cement joint. A lead joint

requires more skill of the mechanic type, but a cement joint can be made by an intelligent laborer, and by almost any intelligent laborer, if he is properly instructed, in a very short time. The proportions of cement to water that are given to laborers can be gotten by proper measures, and care must be taken in not allowing the cement to become partially set before it is used in the joints. I think another point in regard to lead joints that has not been brought out is that when a lead joint is driven too hard in the main it places the main under tension and makes it less flexible as it is being laid than a cement joint does; that is to say, that when a lead joint main is laid the driving up of the lead draws the entire main into tension, and when the trench is filled in it is liable to be and necessarily must be more or less depressed or elevated by tamping in the dirt around the main. In the cement joint the cement is placed in the main when the pipe is bedded on its foundation, and does not draw the main into tension, and, therefore, it gets a better and more even bedding than it can under lead joint conditions.

THE PRESIDENT—Any further remarks? If not, Mr. von Maur will close the discussion.

MR. VON MAUR—The first question asked was whether we used the same bell for lead as cement? We do.

The second question, I believe, was what precautions do we take in laying large pipes during hot weather? In every case we fill in between the bells before any joints are made. This is to make the pipe rigid, so that it will not move or be disturbed after the joint is made, and also to partially cover it from the sun. In laying large pipes in addition to the above, we cover the joint, after it is made, with burlap and keep this burlap wet by sprinkling water on it from a sprinkling can. As soon as the test is made we immediately commence filling in and endeavor to get all the pipe covered as soon as possible. Care must be taken in filling in not to jar the joints with the rammers.

3d. Regarding Mr. Forstall's remarks as to whether it pays to lay pipes with cement joints in the business sections of the city, I will say that there is only one way to prove this absolutely, and that is to try it. If we are following any certain practice, such as making joints with cement, and find that it is a success throughout the city where it has been tried, and that lead joints have not been a success in the business sections of the city, why is it

not good policy at least to make the experiment and try the cement joint in the business sections of the city? We intend to do so. I might say that since this paper was written we made an experiment with a 4-inch line of pipe, with cement joints, parallel to a steam railway and only 10 feet away from the rail. It has only been in for a few months, and I do not know whether we will have any trouble with it or not, but this line replaces a cast iron main which was laid with lead joints, which main leaked and broke continually. A serious accident resulted from one of these leaks and also resulted in an expensive lawsuit for the company. I have every reason to believe that the present main laid with cement joints, will cause us far less trouble than the one it replaced.

4th. As for laying pipe in soft places, my contention is that the experiments we made showed that a pipe laid with cement joints did have more elasticity than we usually supposed it had. We showed in one experiment that the pipe sagged 15 inches before a leak developed. You will hardly ever get more sag than this, even in soft ground. Furthermore, we have laid pipes in soft ground, which have now been in use for over 2 years, and up to this writing we have had no trouble from them.

5th. As to removing the cement from the joint when it is necessary, I have always found that this was a very hard thing to do. I know of no simple process by which this can be accomplished. At present we are simply gouging the cement out.

6th. Regarding electrolysis, I cannot agree with Mr. Doty that it is the universally accepted opinion amongst engineers that it is better to have a good conductor than a bad one for your pipe lines. Where does the damage from electrolysis become most serious? Is it more on the service pipes than on the main pipes? I have always found that it is a great deal more serious on our wrought iron and steel pipes than on our cast iron pipes. If we make a perfect electrical connection with the street railway tracks, the current is conducted through the mains and from the mains to the service pipes which frequently pass under the tracks. The current leaves here for the rails, causing the damage—more so, I believe, than if the mains had been made a poorer conductor and less current had passed through the system. Furthermore, I believe that the general policy of connecting up our pipes with the street railways, and making them a part of their system, is a

very bad one. If at any time the street railway company makes a change in the location of the power house, or the circuits, the electrical conditions previously existing in the gas system of mains and services may be thoroughly changed and you would have to do all your work over again. We have a line of pipe in St. Louis made of cast iron pipe with lead joints, and thus of low electrical resistance and yet we have found that unprotected services on this line are destroyed in about 5 weeks. Measurements made on this line show a very strong current flowing through it, so that this would illustrate very well the damage to the service pipes to be entirely due to the heavy current flowing through the main. I believe that had the main been insulated the current would have been less and the damage correspondingly decreased.

7th. Referring to the matter of costs, I can only say that the costs that are submitted in my paper are based on actual experiments.

8th. Whether pipe can be laid in frost or not I am not prepared to say, except that I am given to understand that in Chicago a line of 16-inch pipe was laid with cement a number of years ago, and on writing the Engineer of the People's Gas Light and Coke Company, asking whether they had any trouble with this line, I was informed that they never had any trouble from it. Now, I should judge the frost in Chicago would reach about the same depth as in Milwaukee; I may be mistaken. Since they have no leaks in Milwaukee in pipes laid in the frost with lead joints, then there cannot be any movement of the pipe line, and if there is no movement of the pipe line, then cement should do at least equally as well as lead, for it must be remembered that the main advantage claimed for a lead joint is that when the frost moves the pipe it causes a number of lead joints to move slightly, the line not being rigid. This would result in a number of small leaks around the joint.

9th. As for any danger existing from strikes on account of training a large number of laborers to make cement joints, I believe that the more laborers we train to be expert men the better off we are going to be. Last spring we made it distinctly understood that no caulker or foreman could work for the company during the winter who was not able to make cement joints by December. It is surprising what a large number of good men

we developed in a short time. In carrying out this policy, we practically flood the market with good men, who, while not really expert caulkers, are expert cement joint makers. This is a good thing for the company and a good thing for the men.

On motion of the Secretary a vote of thanks was extended to Mr. von Maur for his very excellent paper.

THE PRESIDENT—The next paper on the programme is on the

USE OF TAR AS FUEL IN BENCH FIRING,

by Mr. F. C. Sherman, of New Haven, Conn. As the author is not present the Secretary will read the paper:

At the request of your Secretary, I submit "Some Notes on Tar Burning." I do this most willingly, for from what I know of the tar market and the inquiries I get in regard to burning tar, the difficulty of disposing of it and the utter lack of demand in New England for water gas tar, this question of disposing of it is a "burning one," and is forcing itself upon the attention of the managers of gas works. I am convinced that in many instances too little attention has been given by the engineer in the matter of consuming tar in the retort furnaces and in the steam generating plant. A short and unsatisfactory trial has discouraged them and caused them to abandon it. They have brought up against the smoke nuisance, variable heats, destructive cutting flames on settings and obstinate stokers who object to any change in firing, even when it reduces their labor. The number of papers that have been read before the different gas associations on this subject is legion and is only equalled by papers on naphthalene. There would seem to be no excuse for the ignorance in regard to the feasibility of using tar for fuel or of its value as compared with solid fuel. Still with all of this available information, tar is being offered at prices far below its value as fuel. It is easier to sit down and denounce the tar combine than to make persevering efforts to burn it successfully; and here I would say that I think we have an exaggerated idea of the profits of the tar trusts.

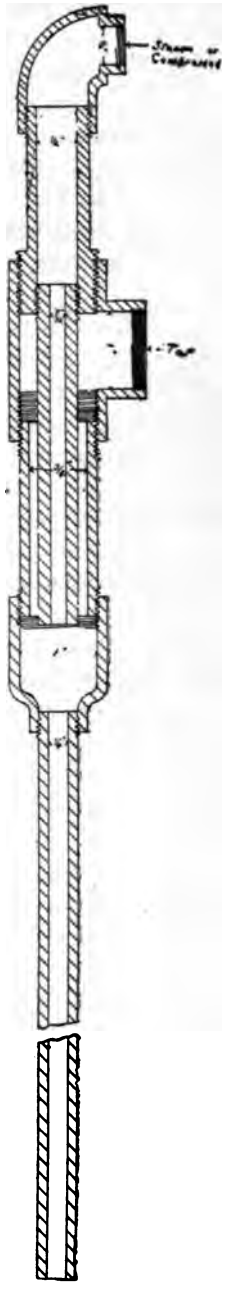
In tar distilling four-fifths of the residual product is pitch and most of the time this is a drug in the market. To any who are thinking of experimenting with tar as fuel in their retort furnaces I will tender the experience of the New Haven Gas

Company for 25 years in its successful use, and if this record is of any service to them in solving any difficulties that may overtake them in their first efforts in this direction, and be the means of relieving the glut in the tar market, I shall feel amply repaid for jotting down these brief notes on an old, threadbare subject.

The New Haven Gas Company has burned its surplus tar for the last 25 years. What I mean by surplus tar is that which we cannot dispose of at its value for fuel purposes. In other words, if we cannot sell it for its fuel value, we burn it. We have tried several burners, among them the Parsons, and the Standard Oil Burner. The one we are using for the last 10 years I first saw at the works of the Newark (N. J.) Gas Company. It is a very efficient burner, giving very little trouble in the way of clogging and costs a very moderate sum. I enclose cut of it, and also send you a sample burner ready to connect. Any gas-fitter can make one. Our feeding tar tank 4 feet by 9 feet is placed alongside the retort house, elevated 20 feet, the tar running by gravity to furnace. In winter we heat the tar in tank by steam coil. It is desirable to have a large tank for uniform pressure at the burner. Compressed air or steam can be used with this burner. We fitted up a Westinghouse air pump in retort house, giving 16-inch water pressure. We get the best results with a steam jet. In order to overcome the variations in steam pressure, we use a regulator which keeps a uniform pressure of 50 pounds on burner. The tar is pumped to receiving tank, passing through a screen that removes the dirt and lumps. The tar valve is open full and quantity admitted to furnace is regulated by steam jet; if more tar is required steam pressure is reduced; if too much is being admitted pressure is increased. There is but very little smoke if the steam pressure is kept uniform and the valves adjusted if smoke is produced, and here we run against the stoker who has got into ruts. He prefers to shovel and clinker rather than adjust a steam valve occasionally, and unless he is kept up to his duty, smoke will fill the retort house, and this incomplete combustion will close the flues of the settings, occasioning serious annoyance and loss. We have had to let down benches to remove the solid carbon in the flues. We use benches of 6's, half-depth furnaces, and work on 4-hour charges; use ⅓ coke produced, or 65 bushels in 25 hours; 150 gallons of tar will do the same work in our furnaces. Given the

price of coke it can be easily figured the worth of tar for fuel. We get 10 cents a bushel for our coke, which would make our tar worth $2.16 per barrel of 50 gallons. We make all our steam with water gas tar for which there is no demand in our State; besides making all our steam with water gas tar, we use it under our retorts, the same burner used with coal tar and with equally good results. We use in our steam plant a different burner from that used under retort benches. On the outlet of our retort furnace burner we put an atomizer such as is used in the oil distributers in the Lowe water gas apparatus. This sprays the tar and steam in the boiler furnaces. We take the water gas tar from a separator and pump it into the receiving holder tank, getting in this way oil gas tar free from water. We have found very little difference in the life of our retorts and settings since we substituted liquid for solid fuel. We find for steam making three barrels water gas tar is equal to 1 ton bituminous coal.

I close this paper by saying that, with our present methods of burning tar, it should not be disposed of for less than its real fuel value.



NEW HAVEN BURNER

DISCUSSION.

THE PRESIDENT—Gentlemen, this paper is before you for discussion. Mr. Baehr, will you speak?

MR. BAEHR—Mr. President, I have a few notes here on some evaporative tests that were made in St. Louis to determine the value of coal gas tar and water gas tar. I would like to say that the results that are gotten from the burning of tar naturally depends very largely on the percentage of water in it, any considerable per cent. reducing the calorific value of the material and consequently the method of burning the tar, the apparatus for burning it, the size of the combustion chamber, etc., have a very large influence on the result. St. Louis has cheap fuel coal, and I will give you

the test. Evaporative test of Zeigler mine run coal, which mine is owned by Joseph Leiter. The cost of that coal (mine run), delivered in our quarters, is $2.07 per ton. The calorific value determined in the laboratory was 11,207 B. T. U. to the pound. At the time of making the test the boiler thermal efficiency was only 66 per cent. I am unable to say why it was so low. I have not a full report with me. The equivalent evaporation from at 212° F. of a pound of coal was 7.8 pounds of water. After determining the evaporative value of the Zeigler coal we got some Pintsch gas tar. This tar analyzed at the time of the test $4\frac{5}{6}$ per cent. of water. The calorific value per pound of tar was 12,104 B. T. U. That is a low value for tar, and the large percentage of water undoubtedly accounts for it. The weight of this tar per gallon was 10.83 pounds. The boiler thermal efficiency at the time of the test was only 43 per cent. That shows that the combustion chamber, the apparatus for burning this tar, was not properly adapted to get the best results. The equivalent evaporation per pound of tar was only 5.33 pounds of water. The commercial value compared to Ziegler coal, and I am quite sure that its commercial value was computed without taking into consideration the boiler efficiency at the time of the test, was only .79 of a cent per gallon. Subsequently a test was made with water gas tar. The percentage of water in the tar at the time of the test was .2 per cent. The calorific value of the tar was 16,495 B. T. U.; boiler thermal efficiency, 59 per cent.; equivalent evaporation per pound of tar, 9.96 pounds of water. The commercial value compared to Zeigler coal per gallon of tar was 1.27 cents. I think there is no question, Mr. President, but that the value of tar would be considerably above the figures we arrived at in these tests if the apparatus was of the most improved kind and we had a higher boiler thermal efficiency. The combustion chambers are not well adapted for tar burning. The boilers under which these tests were made were Heine water tube boilers of about 2,225 square feet of water heating surface.

THE PRESIDENT—Any further discussion? If any gentleman has an idea on this subject we would be very glad to hear from him. We want to make the discussions more general, if possible.

MR. WARING—I would like to say that on the E. & W. boilers we got an efficiency of 13.88 evaporations per pound of tar.

THE PRESIDENT—13.88 pounds of water per pound of tar. Was that coal or water gas tar?

MR. WARING—Water gas tar, free from water.

MR. HAINES—I would like to ask Mr. Baehr if that cost of coal at the boilers ($2.07 per ton) includes the entire labor of handling the coal and moving the ashes incident to it; whether that is all the labor incident to using coal?

MR. BAEAR—My recollection of that figure is that the cost of removing the ashes is included, but I would prefer to look up my record before giving a definite answer on that point.

MR. HAINES—I would like to ask Mr. Baehr whether that equivalent value of the tar also includes the labor reduction in the handling of tar?

MR. BAEHR—I am unable to say. I can give the gentlemen those figures after I return to St. Louis. I had to make the most of those figures from memory.

MR. FITZGERALD—I would like to ask Mr. Waring where he got that 13.88 pounds of water to the pound of tar, how he regulated his air, how much air he put under the furnace? Did he carry the furnace doors open or keep them closed in making the test?

MR. WARING—We used a tar device, which, I think, was gotten up by Mr. Prichard, of Lynn, Mass. We don't admit any air at all under the grate bars. We don't change our settings at all. We have stationary grates, and we merely put clinkers over the grate bars and close the ash doors tight. The spray is a steam pipe under the tar pipe, which merely atomizes the tar, and air is drawn in through an opening in the firedoor. The reason we use this device is because we can change from tar to coal in a very short time. I got my remarks reversed. I meant to say that we do admit air from the ashpit, and Mr. Prichard advocated not admitting air in the ashpit. We had a serious explosion, burning the fireman and engineer who happened to be in front of that door, by gas generating in the ashpit. After that we merely cracked the door to admit enough air to carry away the gas. We get splendid efficiencies by burning tar. Our tar merely gravitates from an over-head tank.

THE PRESIDENT—Any further remarks. Does the Secretary desire to close the discussion?

THE SECRETARY—No sir.

On motion a vote of thanks was passed to Mr. Sherman.

A recess was ordered until 2 P. M.

FIRST DAY—AFTERNOON SESSION.

The sessions were reconvened, pursuant to motion for recess. The President introduced Mr. W. A. Baehr, of St. Louis, Mo., who, as Editor thereof, presented the following

BUDGET FROM THE WRINKLE DEPARTMENT.

Upon assuming the duties of Editor of this department last year I at once began to resolve the possibilities of the wrinkle work in my mind. Almost all of my predecessors had stated that the field was becoming exhausted and that securing new wrinkles was growing more difficult each year. I accepted this view partially, and thereupon set out to determine if new fields existed. There are fields, and ample ones, too, but the use of them for this purpose depends very largely upon the limitations imposed upon the Editor by the definition the Western Gas Association gives to the word "wrinkles." If you confine this work to a record of those usually simple and practical devices which enable us to overcome the minor difficulties of our business, you limit the field and render it extremely difficult for the Editor to really devote much earnest effort to it.

If, however, our worthy Association will broaden the definition to include all devices, formulæ, expedients and scientific methods of accomplishing objects appertaining to the entire gas business, in addition to the minor practical devices, the field is unlimited. Wrinkle and progress departments, question boxes, etc., can all be considered as educational institutions, and consequently there can be grades of wrinkles, as well as educational grades in school. I preferred to consider the broader definition of the word "wrinkle" as before mentioned, and with that as a basis requested contributions for the year.

One circular letter was sent out to the members of all Gas Associations, and the Editor supplemented these by a personal letter to such members who, to his knowledge, were able to contribute. A number of very courteous responses were received, and the Editor feels reasonably gratified at the result.

I do not think the wrinkles this year show as much gradation into the higher classes as I would like to see, but I think the start has been made. I take this occasion to express my hearty thanks to the contributors for their efforts, and I wish to

acknowledge my appreciation for the valuable assistance rendered by Mr. George S. Hessenbruch, Chief Draftsman, Laclede Gas Light Company, of St. Louis. I wish to call attention to the drawings accompanying these wrinkles, for which Mr. Hessenbruch is largely responsible, and I am free to state that he will gladly send a blueprint from the original tracing to any member who is particularly interested in any one point. The wrinkles have been classified as follows:

General; general construction; coal gas; water gas; chemicals; distribution; meter.

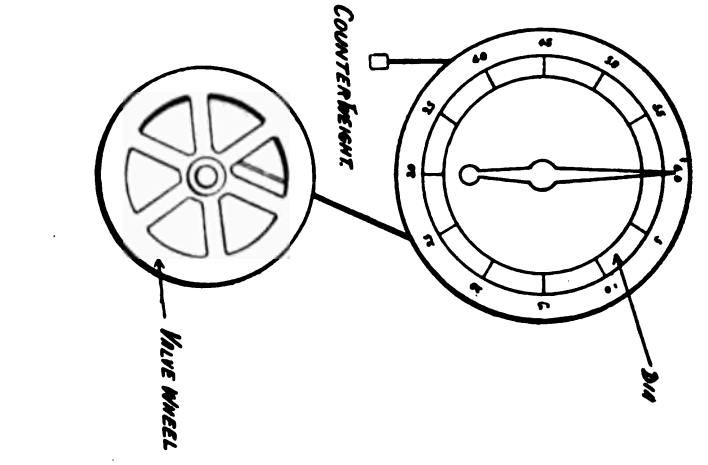
GENERAL.

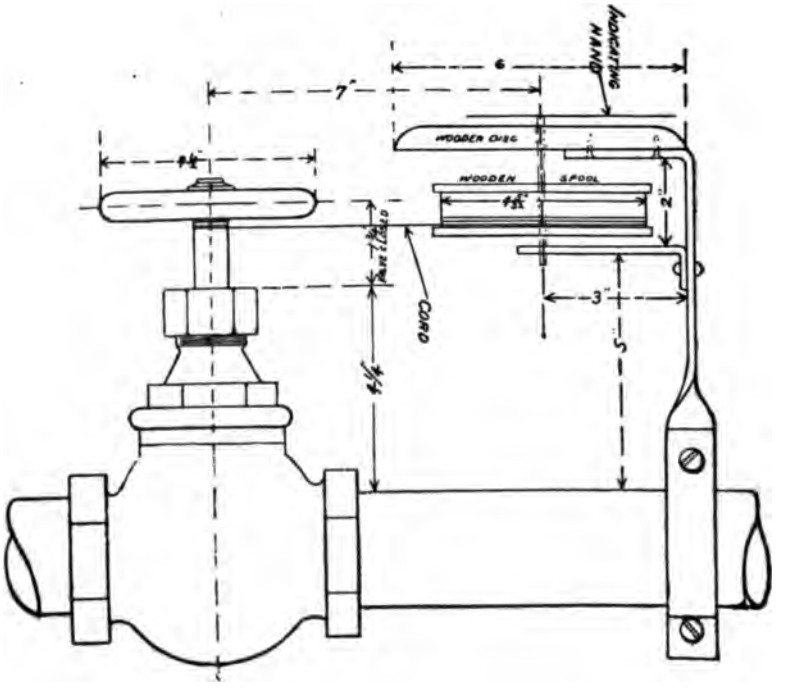
No. 1.—"*Device for Indicating the Number of Turns that a Valve is Opened.*—As will be seen from the accompanying sketch, a cord is attached to the stem of the valve, and thence runs over a small drum around which it is wound several times, and having a small counter weight on the free end of the cord. This drum communicates with an indicating hand which registers the number of turns that the valve is opened on a dial. When the valve is opened the stem turns and winds up the cord, turning the drum and moving the indicating hand."—G. D. FISHER, Supt. Station B, Laclede Gas Light Company, St. Louis.

No. 2.—"*Method of Rigging up a Gasoline or Naphtha Vaporizer in a Small Works.*—The writer fitted up one with an old gas water heater coil, placed in a cylinder made of 6-inch pipe and connected directly in the steam line to exhauster. The idea of placing the apparatus in steam line to exhauster is to get the best results from the heat of steam and at the same time use as little as possible. The scheme works very satisfactorily when used with a sightfeed and can be operated continuously."—S. R. WALKER, Laclede Gas Light Company, St. Louis.

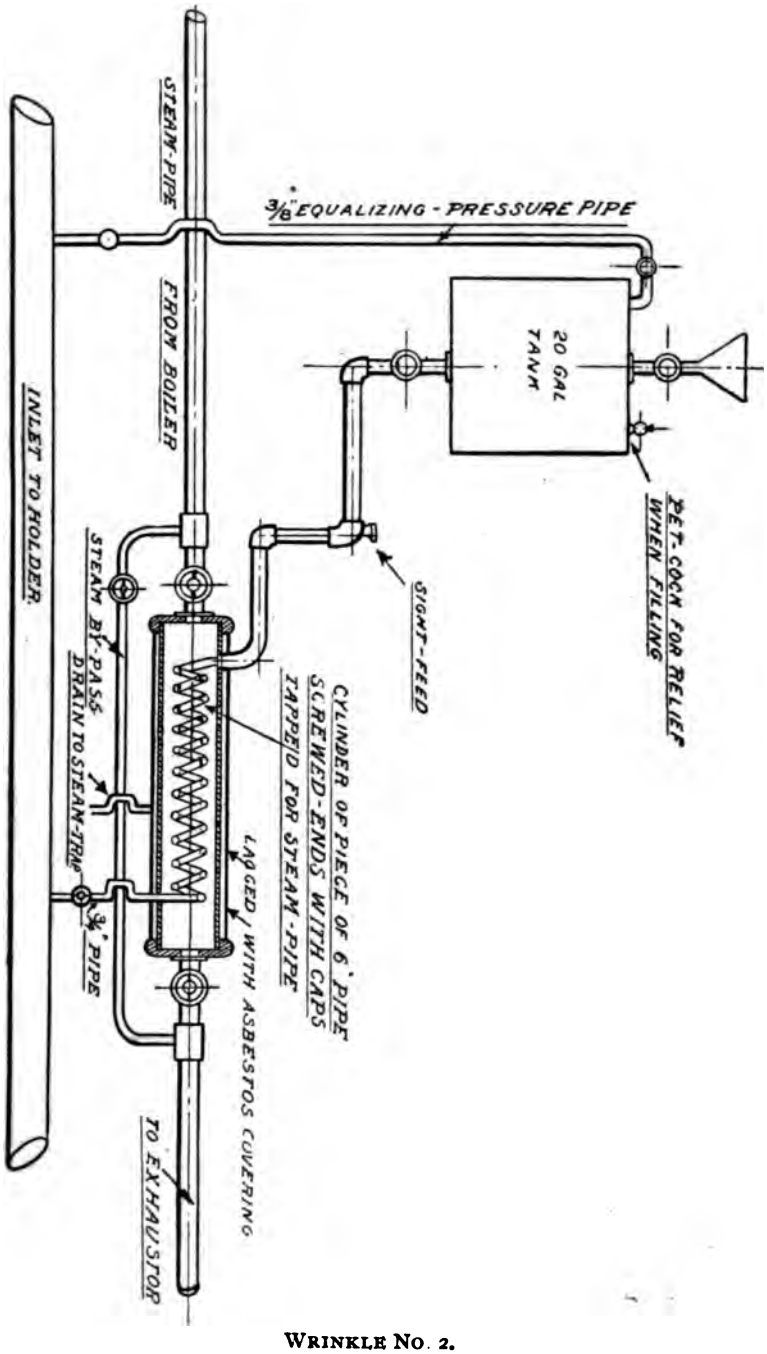
No. 3.—"*Device for Observing the Height of a Relief Holder at Night.*—At Station A, Laclede Gas Light Company, the relief holder for water gas is small when the capacity of the plant is considered. The capacity of the water gas plant is 8,500,000 cubic feet per 24 hours, and the capacity of the relief holder is 150,000 cubic feet. The holder moves up rapidly at times and is in danger of blowing unless carefully watched. The exhauster is located some 200 feet away; so to keep watch on the height at any time during the night the following device was installed:

"An incandescent lamp was placed on the top strut of the guide framing, which shows the height to which it is safe to



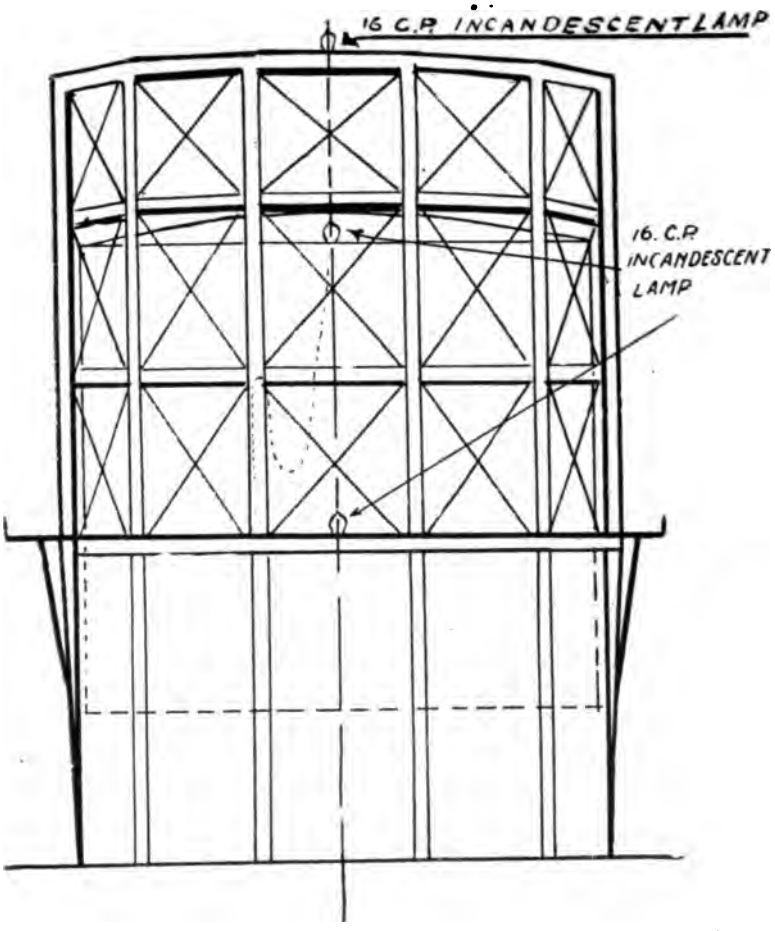


WRINKLE NO 1.


STEAM-PIPE
3/8" EQUALIZING - PRESSURE PIPE
FROM BOILER
20 GAL TANK
PET-COCK FOR RELIEF WHEN FILLING
INLET TO HOLDER
SIGHT-FEED
STEAM BY-PASS
DRAIN TO STEAM-TRAP
CYLINDER OF PIECE OF 6" PIPE SCREWED-ENDS WITH CAPS TAPPED FOR STEAM-PIPE
LAGGED WITH ASBESTOS COVERING
3/4" PIPE
TO EXHAUSTOR

WRINKLE NO. 2.

allow the holder to rise. Another lamp was placed at the curb line of the inner lift, which, of course, goes up and down with the inner lift, and a third lamp on the edge of the walk-around. The relative position of the 3 lamps shows the engineer at a glance whether or not the holder is in danger of blowing or

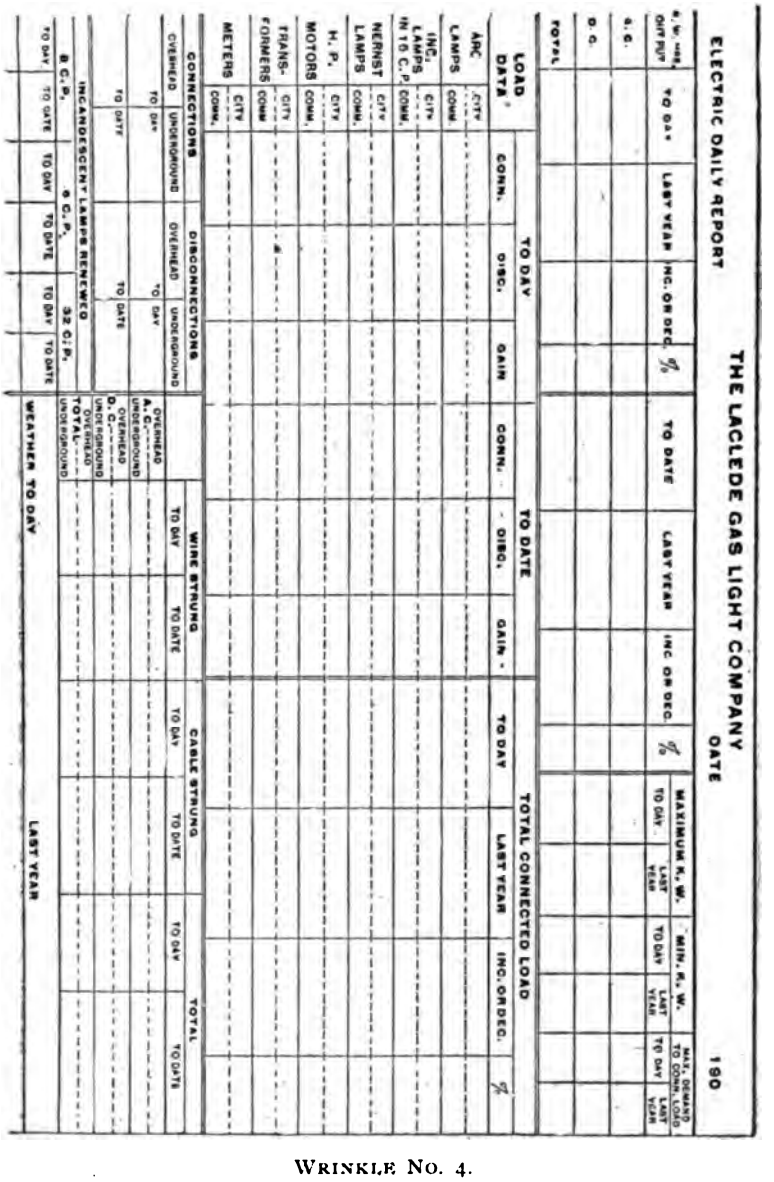


WRINKLE NO. 3.

landing. The accompanying sketch illustrates the scheme."—GEO. B. EVANS, Laclede Gas Light Co., St. Louis.

No. 4.—"*Data Card for Electric Department.*—The card shown is self-explanatory. Anyone taking the trouble to examine this

card closely will find that one is able to put a large amount of information and data into a very small space. This card is filled out daily and shows an absolute record, giving a good oversight



WRINKLE NO. 4.

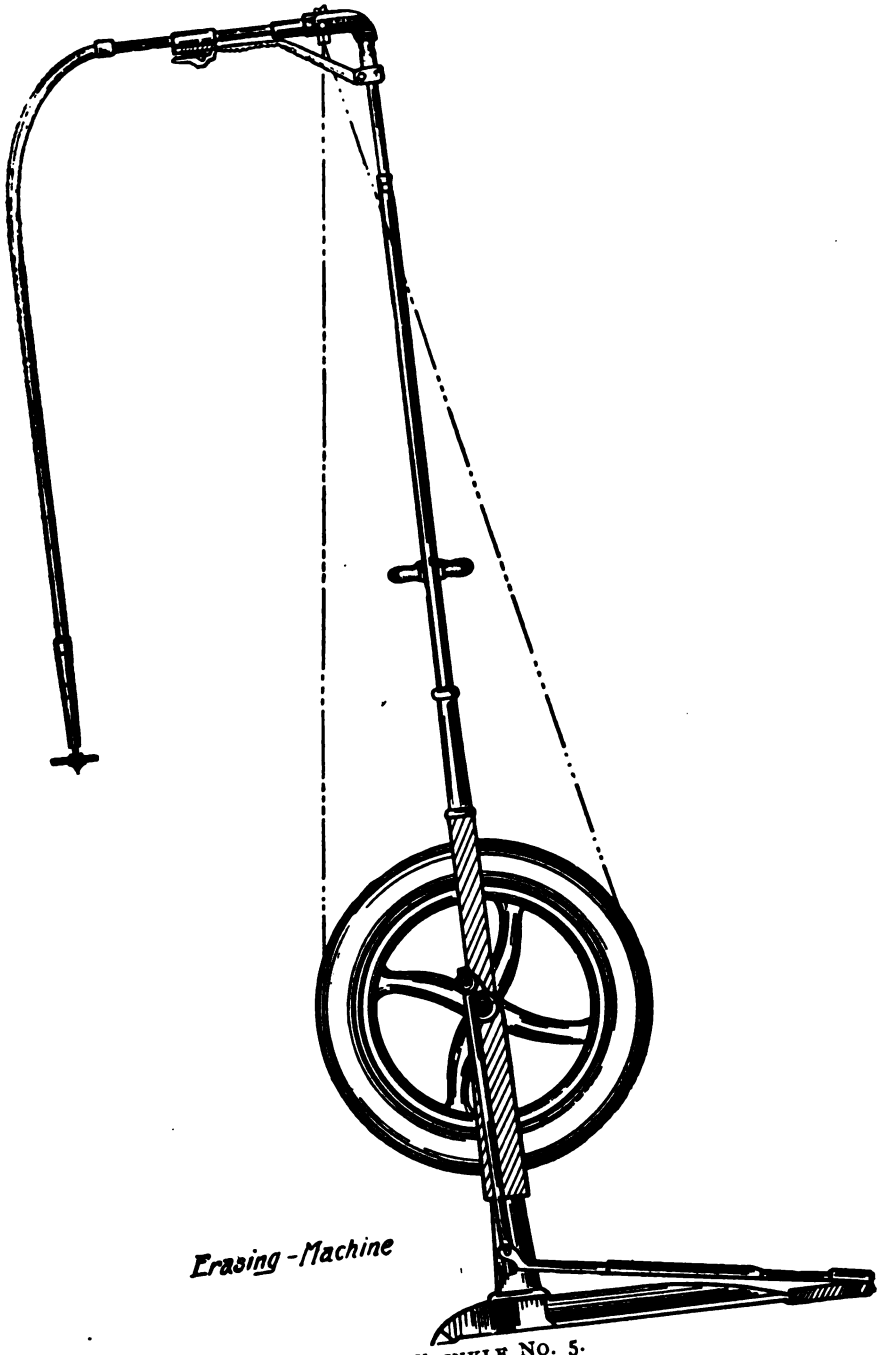
over the whole department."—A. N. GREEN, Laclede Gas Light Co., St. Louis.

No. 5.—"*Erasing Machine.*—In a drafting room where certain records have to be kept, such as street records, plat-books, insurance books, main records, etc., and where these records continuously change on account of new pipes being laid in place of the old ones, there will undoubtedly be a great deal of erasing done. To eliminate the large amount of time and work necessitated in erasing by hand, and to do the work carefully, a scheme was devised to do this erasing mechanically. The scheme is as follows:

"An ordinary dental engine, or machine that is used by dentists for drilling teeth, was procured, and a circular ink eraser set in the mandrel by means of a small screw instead of the regular drill used by the dentist. Everybody is familiar enough with the working of a dental engine without going into a general description of the same. Foot power is used, as is now mostly used by dentists, but a small electric motor could be easily attached and drive the machine without much cost. The flexible shaft to which the eraser and handle are attached allows considerable movement, and all the draftsman has to do is to guide the eraser by means of the handle. Anyone trying this machine will have to watch the following points:

"Keep the machine at a good speed and do not press the eraser hard on the paper, as the machine erases very rapidly. It will be found that a good paper will take on a hard surface at the erased place, and that the erasing will hardly be noticeable. Erasing can be done by the machine in about one-tenth of the the time it would take to do it by hand; besides it is not tiring to the draftsman. It will be found that the draftsman becomes very expert with it and can erase very fast, and when coming to a fine cross line can neatly jump this line without touching it, and at the same time eradicating the line he is working on completely."—G. S. HESSENBRUCH, Laclede Gas Light Company, St. Louis.

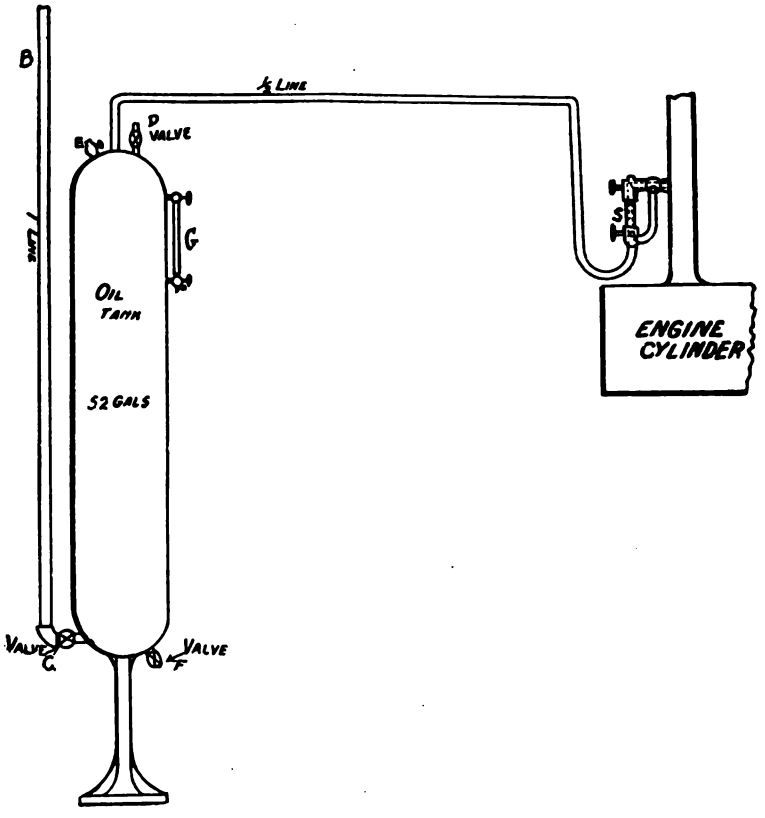
No. 6.—"*Oiling an Engine Cylinder.*—A good method of introducing oil into the cylinder of an engine may be had by arranging a continuous oil-feed, as shown in the diagram. A tank holding a barrel of oil is placed in some convenient corner and a pipe *B* is connected from the main steam line to the tank,



Erasing-Machine

WRINKLE NO. 5.

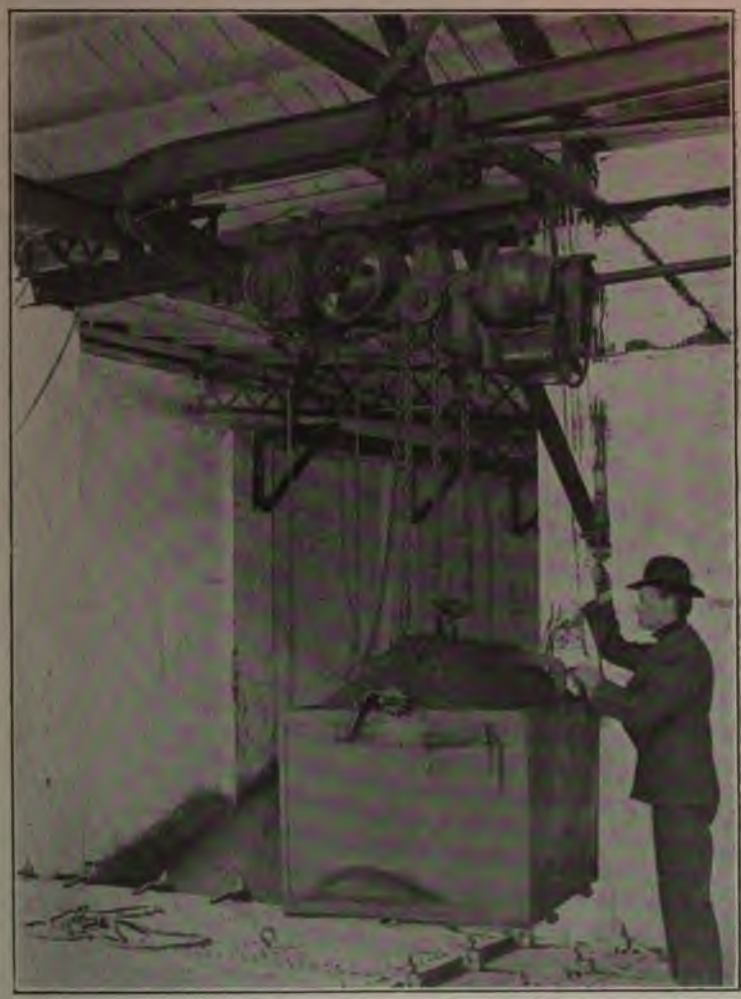
entering at the bottom with a valve *C* near the tank. By the condensation of steam in this pipe, a sufficient head of water is formed to make the oil flow out of the tank through a small oil line to a sight-feed *S*, and thence into the steam engine inlet. To fill the tank, a small rotary hand pump is used and is connected to a valve *D*, after a pet cock *E* has been opened and the



WRINKLE NO. 6.

water drained from the tank by a valve *F*. A glass gauge is placed near the top of the tank to tell when it is empty." —D. MACARTHUR, Laclede Gas Light Co., St. Louis.

No. 7.—"*Oxide Elevator and Trolley.*—The oxide elevator, as seen from the accompanying cut, is on the style of a man trolley and has two motors, one for propelling along the track and one for hoisting. The hopper itself has a dumping bottom."—J. D. SHATTUCK, Chester, Pa.



WRINKLE NO. 7.

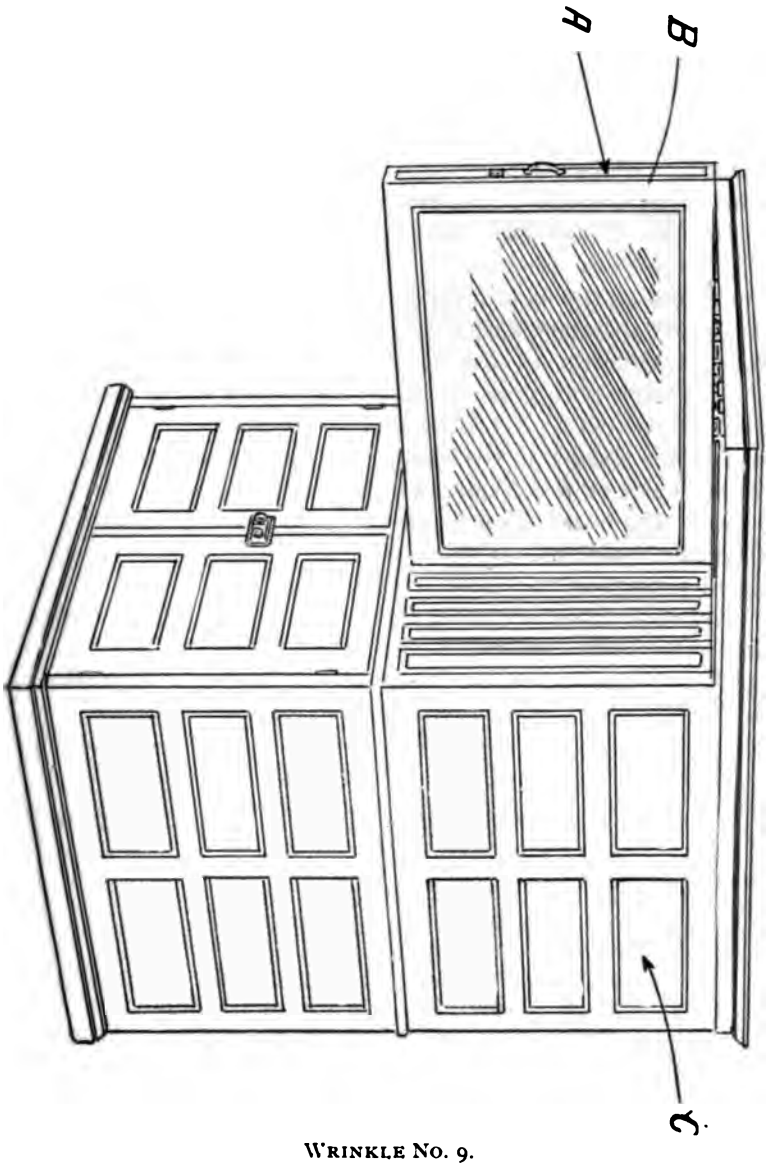
No. 8.—"*Blue Printing Machine.*—The attached photograph shows blue printing machine made by Mr. V. Chartener, Pittsburgh, Pa. The light used for printing is electric. The apparatus consists of a sliding table running on wheels on a track and is moved forward and backward whenever tracings are to be inserted, and also a glass frame which rests on the sliding table during printing. The tracings to be printed are laid

on this table with a paper underneath the tracings; the table is then moved under the glass and is raised by means of bevel gears which work eccentrics inside of the rolling

WRINKLE NO. 8.

wheels of the table. As the table raises it comes in contact with the glass and frame, and raises this glass and frame from its

supports, letting the whole weight of the glass and frame bear on the table and in this manner assures a splendid contact. The glass and frame are covered by a stationary hood in which the



WRINKLE NO. 9.

arc lamps hang. The shape of this hood is such that the rays of light are reflected so that no shadows are thrown, and the intensity of the light is practically the same at all points on the glass. The inside of this hood is painted with aluminum paint, white enamel being found to give too strong a reflection. A print is made in 4 to 5 minutes. The machine shown can take a print 5 feet by 10 feet, and is the largest size made. They can be procured in any size, however. The Laclede Gas Light Company uses such a machine."—G. S. HESSENBRUCH, Laclede Gas Light Company, St. Louis.

No. 9. "*Map Case for Sectional Maps.*—The Laclede Gas Light Company uses maps which represent a section of the city, for recording the main pipes in the streets. To make it handy to inspect these maps without getting them too soiled, a cabinet was constructed, as shown on attached sketch. *B* shows a double frame with glass on each side. This frame slides back into the cabinet *C*. *A* is the board on which the map is mounted and which slides into the frame *B*, showing a section of the city on each side of the frame, which map is protected by a plate glass. The board *A* on which the maps are mounted is locked into the frame *B*. These maps are posted every week."—GEO. HESSENBRUCH, Laclede Gas Light Co., St. Louis.

No. 10.—"*To Prevent Lead Poisoning.*—The attached card is self-explanatory, and it is a good thing to have plenty of these cards posted around the works where the men can see them and act according to the instructions given on this card."

LEAD POISONING.

1st. Wipe off all FRESH PAINT, or RED LEAD with waste before blowing into pipes.

2d. Don't get RED LEAD mixed with your CHEWING TOBACCO.

3rd. Wash LEAD and PAINT off your hands before eating.

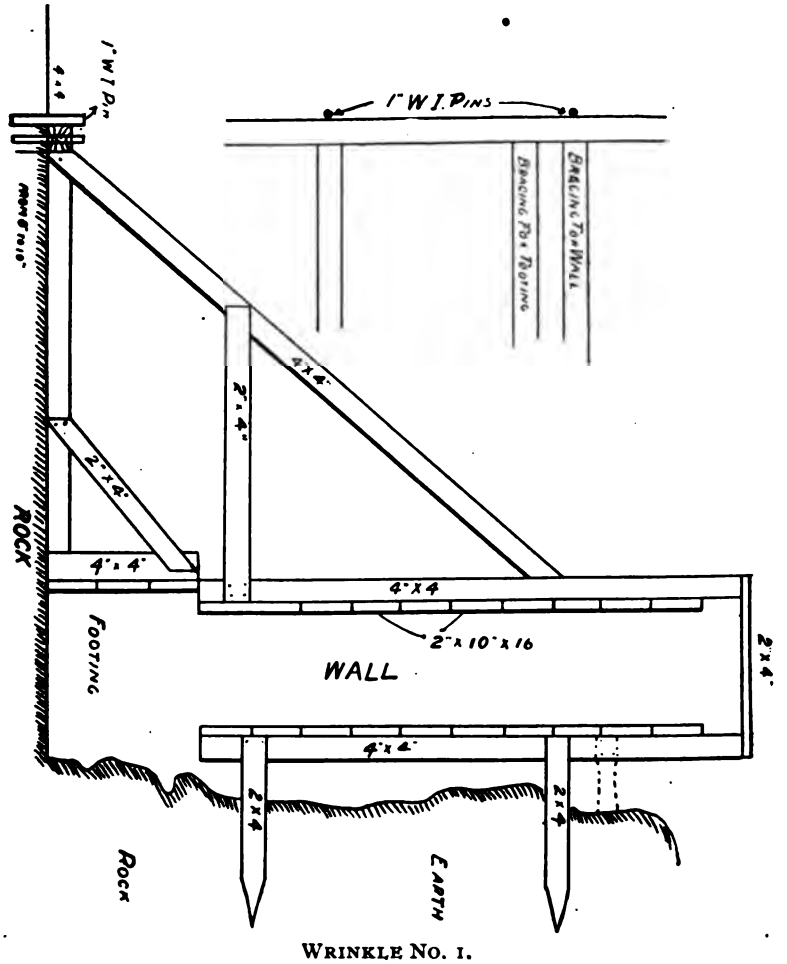
4th. RED LEAD and FRESH PAINT are slowly absorbed into the system from small quantities or stains gotten on the lips or into the mouth. This lead may do no apparent damage for MONTHS, when it will suddenly cause the the severe pains characteristic of LEAD POISONING or may cause LEAD PALSY.

G. W. WHITFIELD, M. D.

No. 11—"*Burning off Mantles.*—To burn off mantles and clean the carbon from tips, I use oxygen gas. I impinge it on the mantle or tip through a fine nozzle after the manner of a hand-blow torch. It greatly improves the Welsbach service, is quick and does not injure the mantle."—M. NISBET LATTA, Charlotte, N. C.

GENERAL CONSTRUCTION.

No. 1.—"*Method of Holding Wooden Forms for Concrete on Rock.*—When erecting a concrete foundation on a bed of rock, where



WRINKLE NO. 1.

it is necessary to have one end of the board trench on the surface of the rock, we use a very simple method that prevents any part of the trench from giving way, bulging or sliding. The drawing shows this method. The footing is first put in and allowed to set, after which the trench for the wall is erected as shown. One side of the trench is braced by driving a 2-inch by 4-inch into the earth, and securely nailing it to the 4-inch by 4-inch upright bracing. This will do very well where the bank is of a soft material, but when it is rock we have a short 2-inch by 4-inch of whatever length is required, between the upright 4-inch by 4 inch and the rock, as shown in dotted lines on drawing. The bracing on the two sides of the trench, together with the 2-inch by 4 inch nailed across the top of the uprights, securely joins the entire trench, and there is no possible way for it to bulge. All parts are properly nailed."—R. E. HAGENAH, Laclede Gas Light Company, St. Louis, Mo.

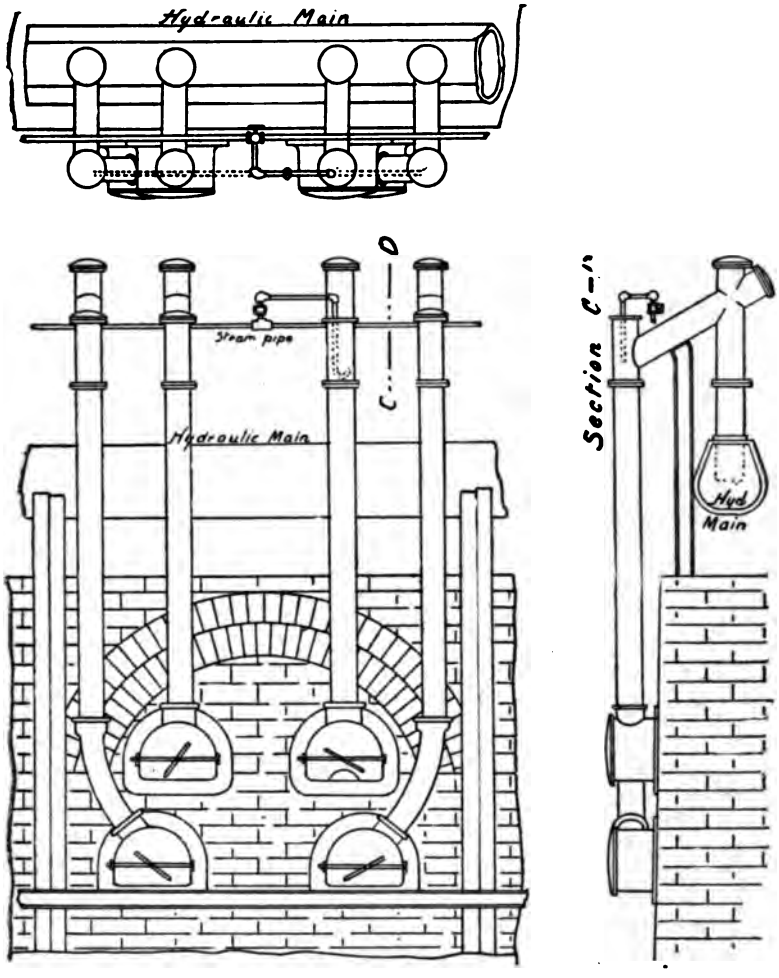
No. 2. "*Method of Obtaining a Smooth Surface on Concrete Work.* To get a smooth concrete surface, particularly on the inside of a concrete arch where it is difficult to keep macadam from showing, we cover the board arch with building paper, and put on the first layer of concrete about 2 inches thick. This layer has but very little macadam, the mixture being about 2-4-1, or 2 3 1. After the boards and paper have been removed the surface is very smooth and nice appearing. The remainder of the arch is finished with the usual mixture of 5–4–1, or 5–3–1."

R. E. HAGENAH, St. Louis, Mo.

GENERAL CONSTRUCTION.—COAL GAS.

No. 1. "*Device for Burning Out Standpipes and Scurfing Retorts.* The accompanying sketch illustrates a method of burning out stand pipes and scurfing retorts in use at Station B, Laclede Gas Light Company, which consists of a permanent steam line, with valve and union at center of each bench. Short lengths of pipe and goosenecks are attached as shown, the regular carbon tile being placed in the retort as usual to within 10 inches of rear and the steam then turned on. We have scurfed retorts in 7 hours by this method, but care must be exercised in regulating the supply of steam or the standpipes will become too hot. The jet can also be introduced into the bottom

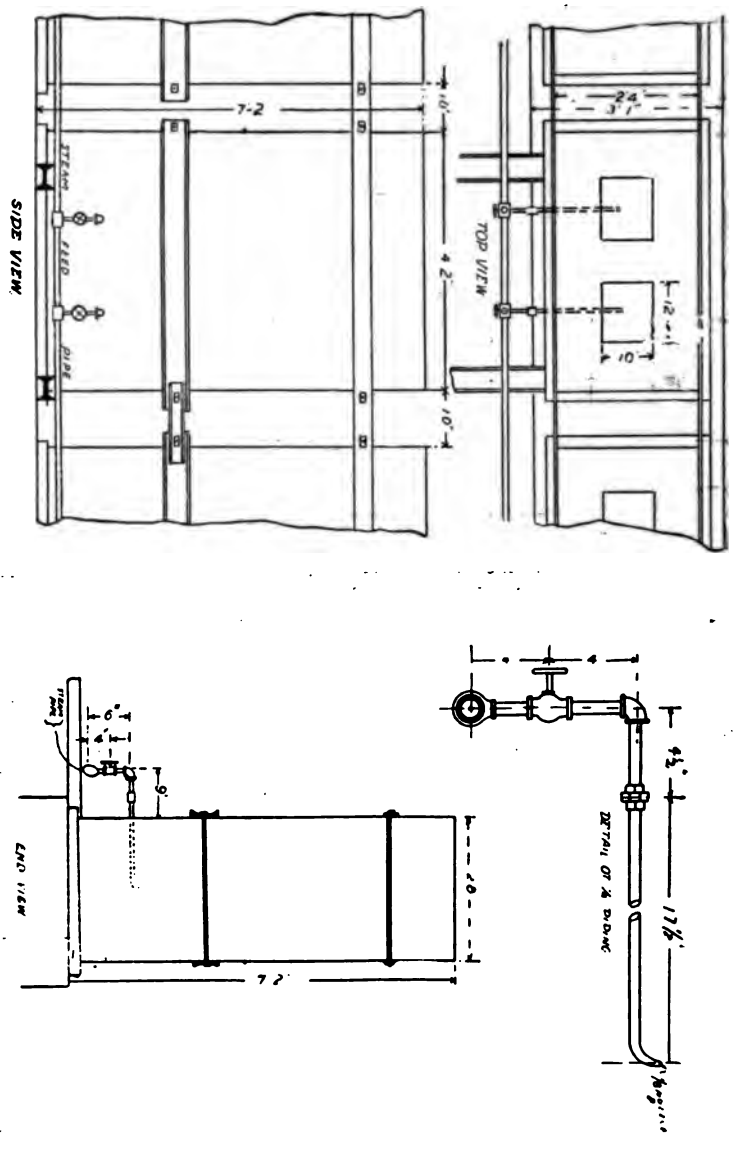
of standpipe."—D. G. FISHER, Laclede Gas Light Company, St. Louis.



WRINKLE NO. 1.

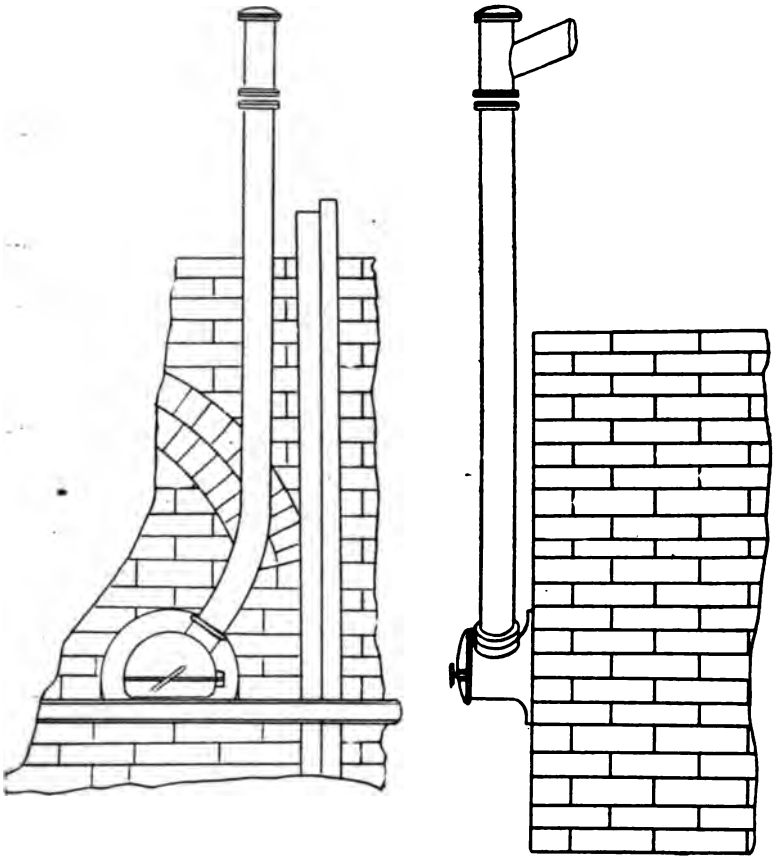
No. 2.—"*Method for Creating Forced Draft in Stacks by Means of Steam Jet.*—The sketch shows this method very clearly. A steam feed pipe is run along the top of the stack, or at some other convenient place. From this feed pipe a small pipe, with valve and nozzle, runs into the stack. By means of the valve the draft can

be regulated and a strong or light draft be created at will."—D. G. FISHER, Laclede Gas Light Company, St. Louis, Mo.



WRINKLE NO. 2.

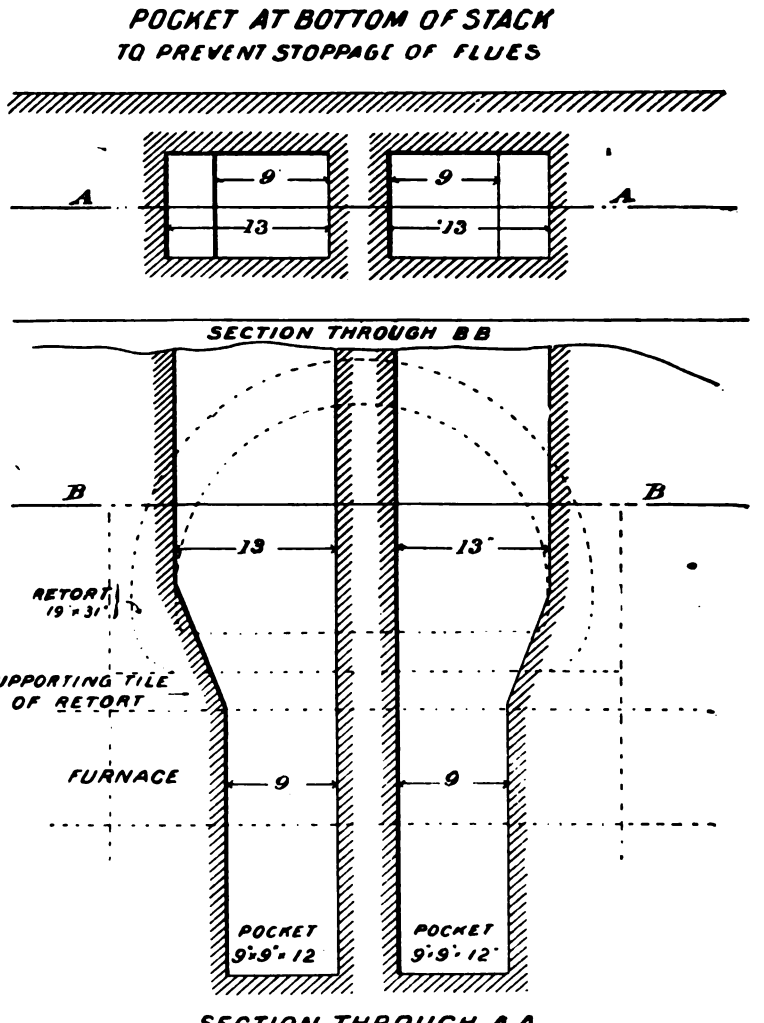
No. 3.—"*Wrought Iron Standpipe for Bottom Retort.*—The wrought iron standpipe seems to collect less carbon and tar than a cast iron pipe and does away with the joint just above the mouthpiece. At Station "B," Laclede Gas Light Company, we have for the past year used an asbestos ring joint with a yellow clay lute at the mouthpiece very successfully. This joint is much



WRINKLE NO. 3.

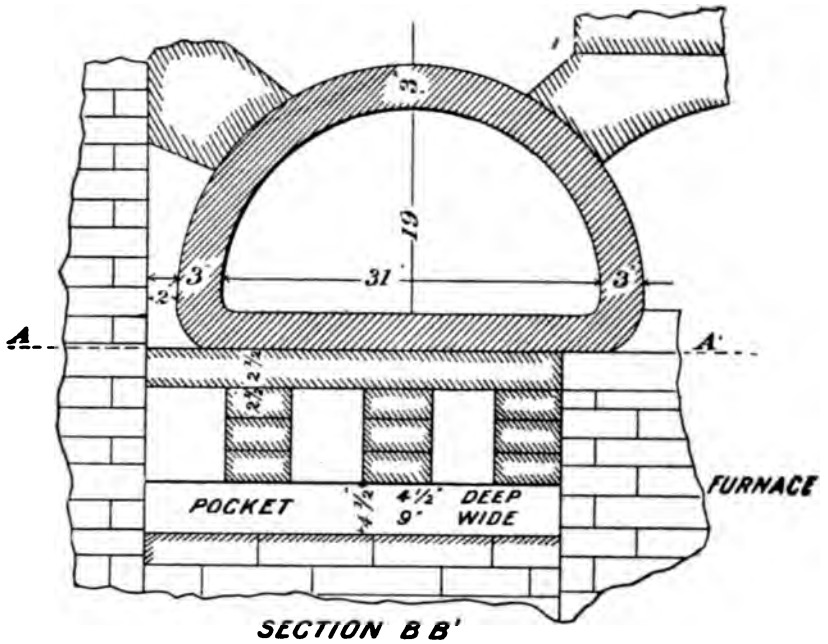
more easily made than the borings-joint, and allows the pipe to expand, which is especially necessary when scurfing. Care must be taken that the base of the pipe does not rest against the mouthpiece."—D. G. FISHER, Laclede Gas Light Company, St. Louis, Mo.

No. 4.—*Pocket at Bottom of Stack to Prevent Stoppage of Flues.*—From the sketch it will be seen that the pocket at the base of the vertical flue prevents any stoppage in the horizontal flue, due to carbon, dirt and slag that accumulate in the stack, and, if

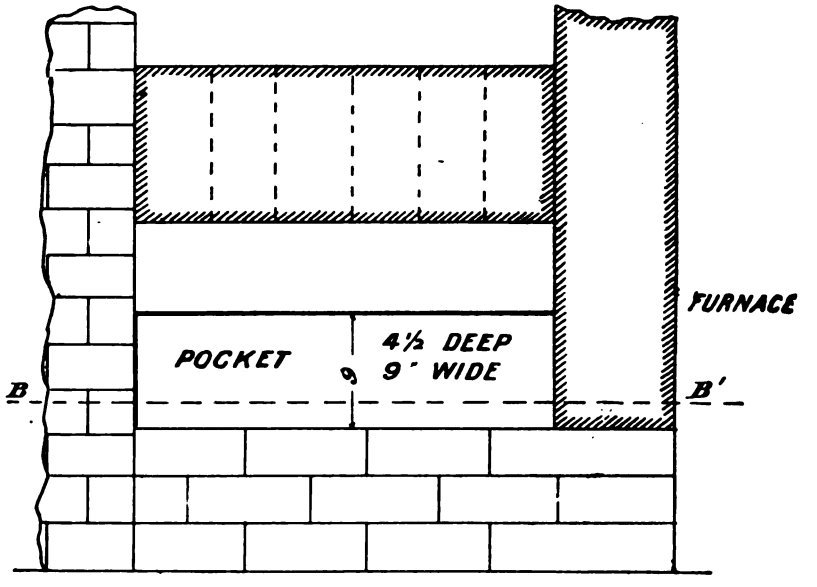


WRINKLE NO. 4.

made large enough, will not become filled during the life of the bench."—D. G. FISHER, Laclede Gas Light Company, St. Louis.



SECTION B B'

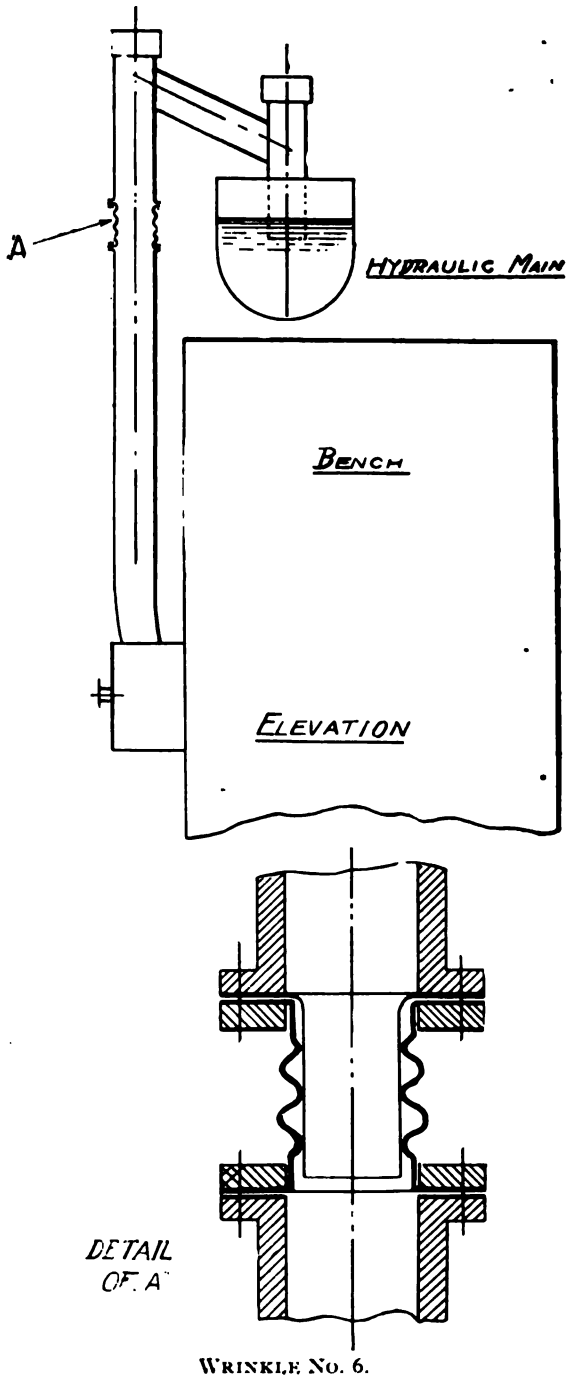


SECTION A A

POCKET TO INCREASE DRAFT UNDER RETORTS.

STA. B. SCALE 1"=10"

WRINKLE No 5



WRINKLE NO. 6.

WRINKLE NO. 7.

No. 5.—"*Increasing Drafts Under and Around Retorts.*—At Station "B" the Laclede Gas Light Company, after having tried everything else, brought up benches that were down by simply removing two layers of brick in the front of the bench as shown in attached sketch. The benches are direct fired. The pocket at the front of the bench seems to increase the draft under and around the retorts."—D. G. FISHER, Laclede Gas Light Company, St. Louis.

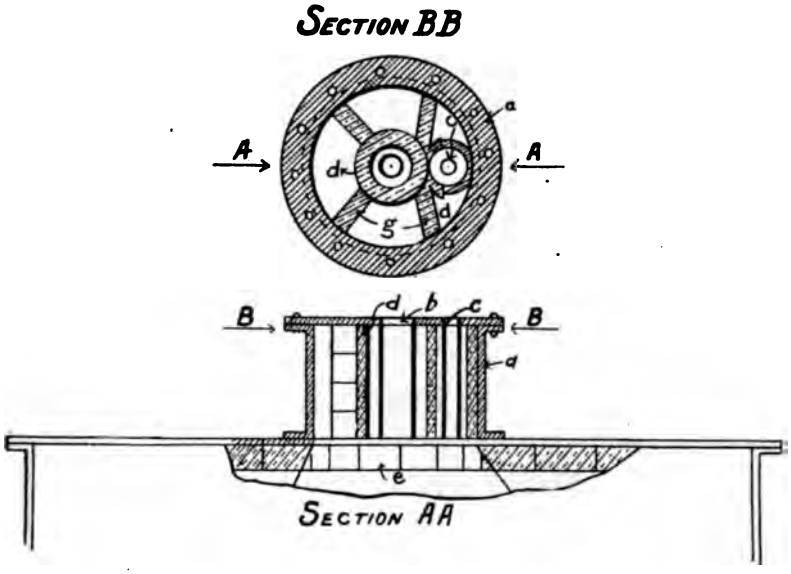
No. 6.—*Method for Allowing Standpipes to Contract and Expand.*—*A* is a corrugated insertion in the standpipe, made of light steel, and held in place by flanges. The straight piece is a protecting cover for the corrugations, so that the tools used for cleaning will not punch holes in the expanding piece."—GEO. S. HESSENBRUCH, Laclede Gas Light Company, St. Louis.

No. 7.—"*New Coke Conveying Apparatus.*—The photograph speaks for itself. Four mules are used; two working during the day, the other two at night. On first training them to work in the retort house each mule has a driver, but after a few weeks they were able to go in and out by themselves. The four mules have displaced eight men in the winter months. These men are at the rate of $2 per shift, making a saving of $16 per 24 hours. In the 7 summer months we paid these men $2.15, making a saving of $17.20 per 24 hours. The mules weigh about 1,000 pounds each, and the cost of their keep is about $1 per day for the four. The mules working in the retort house have had a very quieting effect on all the rest of the labor, and for that reason I would keep them if they were no saving at all. Some of our men have called them the 'New coke conveying apparatus.'"—CHAS S. BEARDSLEE, Cleveland (O.) Gas Light and Coke Company.

GENERAL CONSTRUCTION.—WATER GAS.

No. 1.—"*Emergency Lining for Neck of Carburetter.*—On account of the negligence of a workman it became necessary to place the tile in the neck of the carburetter of a water gas machine for the installation of an oil spray, after the coke fire had been started in the generator. A workman started to do the job, but in a very short time was overcome with gases coming from the generator. The problem was then to construct something that would answer the purpose and which could be

placed in the shortest possible time to prevent others from getting too much gas. Our method of doing this is shown in the accompanying drawing, in which *A* is the neck of carburetter; *B*, opening for spray; *C*, peep-hole; *D*, scurfing tile; *E*, tile in bottom of neck; *G*, 9-inch square firebrick, cut off to fit and to hold scurfing tile in position. The brick and tile were cemented with the usual mixture of fireclay, asbestos, cement and water. After all the material was at hand it took a trifle over 4 minutes to complete the job."—R. E. HAGENAH, Laclede Gas Light Co., St. Louis.

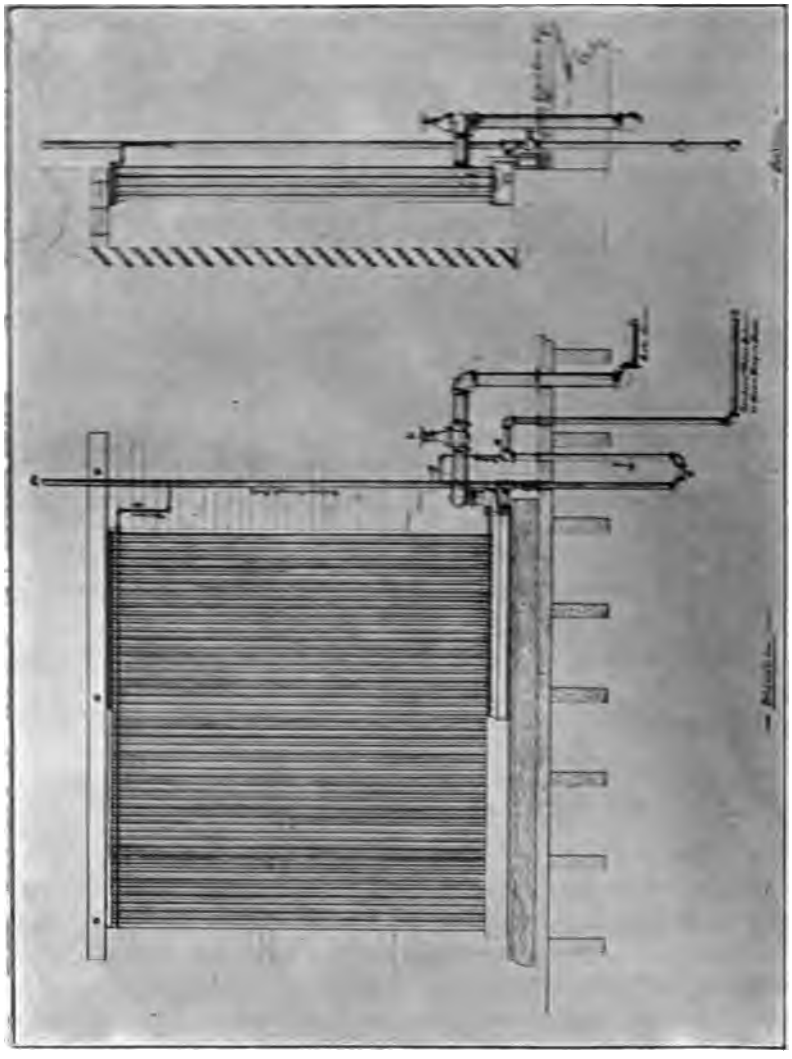


EMERGENCY LINING FOR NECK OF CARBURETTER

WRINKLE NO. 1.

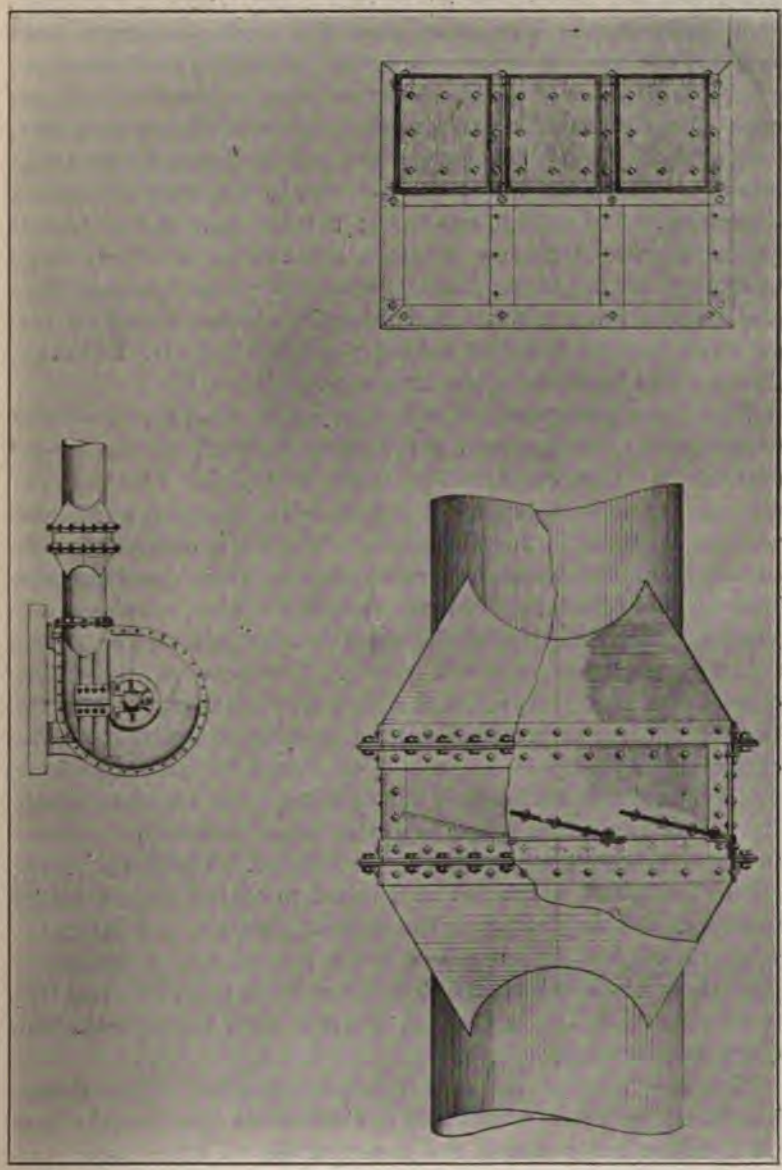
No. 2.—"*Apparatus for Preheating Air for Blowers for Water Gas Sets.*—The drawing shows the method adopted at the various stations of the Peoples Gas Light and Coke Company, of Chicago, to provide the large volumes of air required by the blowers in the engine room for the generators. This arrangement insures air at atmospheric pressure at the blower inlets, obviates the necessity for opening windows and doors, and during

exhaust coil heater warms the air on its passage into the engine room. The drawing shows the pipe arrangement in both side and end elevation. In the side elevation *A* is the supply pipe from the main exhaust steam pipe of the station, and is controlled by the valve *B*. The top and the bottom of the



WRINKLE NO. 2.

heater consist of two hollow steel boxes, the bottom and top sides of which respectively form flue sheets and are joined



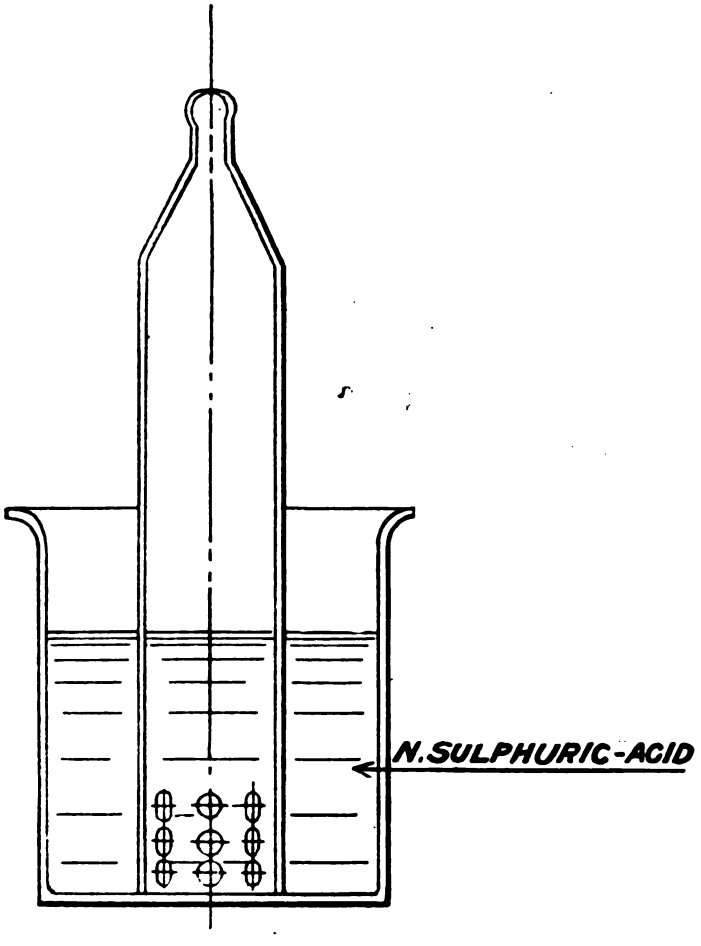
WRINKLE NO. 3.

together by 1-inch pipes. The length and number of these pipes depend upon the size of the opening. The steam enters the lower box and passes into the vertical pipes where it condenses and drains back. The water from the condensed steam flows out through the seal *D* into the sewer. A vent pipe through the roof is provided, and to this the upper box is connected by the pipe *G*, to insure circulation and to prevent the system from becoming air bound. A connection is also made, by means of the pipe *F*, from the top of the seal pipe to the vent to prevent siphoning. The outside opening of this air vent in the wall is provided with stationary shutters, as shown. If a very large volume of air has to be drawn through a given opening, or if the temperature is not raised sufficiently, a second heater or row of pipes may be installed behind the first."—J. H. EUSTACE, Peoples Gas Light and Coke Company, Chicago, Ill.

No. 3.—"*Automatic Check-Valve for Blast-Piping.*—The sketch shows the automatic check valves adopted at the several stations of The Peoples Gas Light and Coke Company of Chicago, to prevent damage to our blowers from any explosions which may occur in the blast pipes. These also control the flow of air from the blowers, prevent the air from the blast-pipe backing out through a blower which is not running, and generally take the place of the old-style blast gate. The device is an arrangement of check valves. The seats of the valves consist of a steel plate set in the blast pipe at right angles to the flow of the air and provided with a number of openings. The checks are made up of ⅛ inch cloth insertions rubber packing ¾ inch larger on 3 sides than the opening. On the fourth side the rubber is 2 inches longer, and this longer projection is bolted to the stationary plate and serves as a hinge. The body of the rubber is shod on both sides with metal plates which are bolted together. These plates give the necessary weight and strength, while the rubber projecting around the sides serves to make the joint tight when the valves close from back pressure from the front side."—J. H. EUSTACE, Peoples Gas Light and Coke Company, Chicago.

No. 4.—"*Lining for Lid of Generator Door.*—The intense heat in the generator of a water gas set causes the wrought iron plate on the under side of the generator lid to deteriorate very rapidly, so that it becomes necessary to replace it by a new one

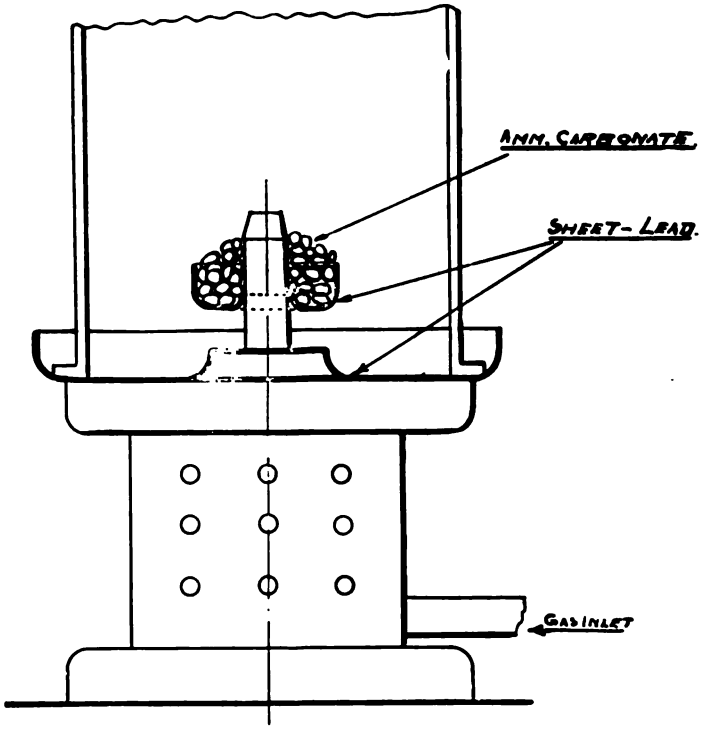
quite frequently. These wrought iron plates do not always keep the lid from getting red, not even when they are new. We did away with these wrought iron plates in most of our water gas generators, and instead we have a layer of ⅞-inch firebrick on the under side of the lid, which is cemented with a mixture of fireclay, asbestos, cement and water. It is safe to say that this lining, if put in with care, will remain as long as any other part of the generator."—R. E. HAGENAH, Laclede Gas Light Company, St. Louis.



AMMONIA-DETERMINATION-APPARATUS.

WRINKLE NO. 1.

No. 1—"*Ammonia Determination Apparatus.*—At the beginning of an ammonia determination, unless one is careful, the air confined in the apparatus escapes rapidly in large bubbles. This gives a chance, although small, for ammonia to escape. To eliminate this chance of error several small holes are bored in the condensing tube, about ¾-inch from the bottom. These allow the air to escape in small bubbles, and insure an intimate contact with the acid (see sketch.")—D. WILSON, Laclede Gas Light Company, St Louis.



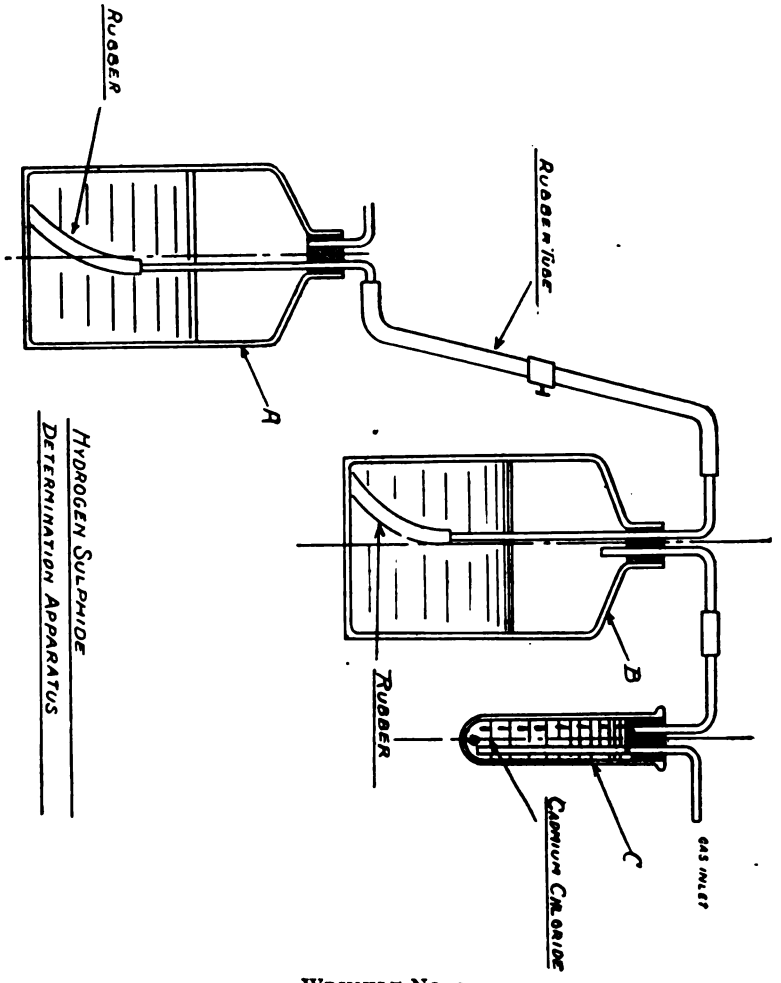
MODIFICATION OF REFEREES SULPHUR-APPARATUS

WRINKLE NO. 2.

No. 2.—"*Referee Sulphur Apparatus.*—When the flame burns low in a referee apparatus there is a loss of sulphur caused by

some of the moisture condensing and running down the side of the trumpet tube into the burner. This water also dissolves the ammonium carbonate, which in turn corrodes the burner rapidly. To eliminate these bad points we made additions to the burner as shown on drawing. At the end of the test the lower dish is washed into the vessel containing the other washings."—D. WILSON, Laclede Gas Light Company, St. Louis.

No. 3.—"*Determination of Hydrogen Sulphide.*—On the sketch



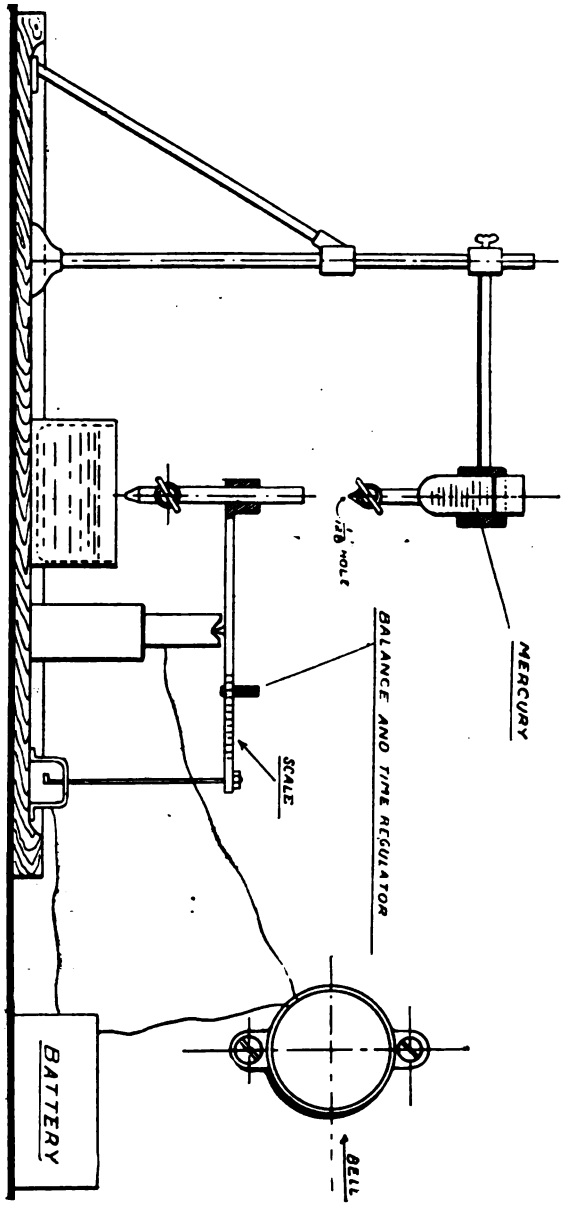
WRINKLE NO. 3.

it will be seen that *A* and *B* are common glass bottles, of known capacity (about 5 pints) arranged to siphon into each other. *C* is an 8-inch wash cylinder, partly filled with alkaline (ammonia) solution of cadmium chloride. The inlet tube of the wash-cylinder is attached to the gas supply and the siphon started. After starting the apparatus requires no attention, for as soon as the upper bottle is emptied the pressure of the water in the lower one stops the flow of gas. The volume of gas passed is that of the upper bottle. The hydrogen sulphide, which has been precipitated as cadmium sulphide, is determined by the usual method, *e. g.*, dissolve the cadmium sulphide in cold dilute hydrochloride acid and titrate with iodine, using starch as an indicator. By means of a pinch-cock on the siphon tube the test can be made to cover any length of time."—B. C. KEISER, Laclede Gas Light Company, St. Louis.

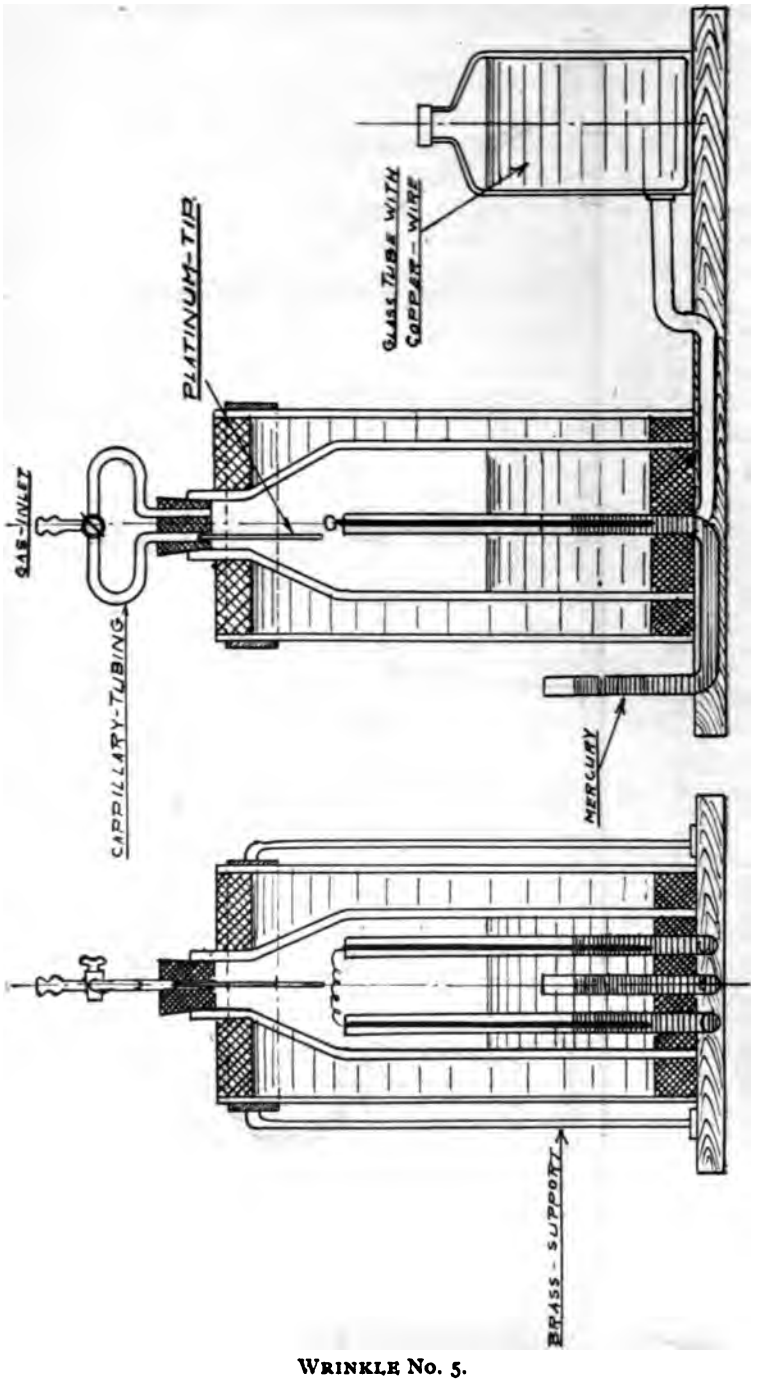
No. 4.—"*An Automatic Timer for Gas Analysis.*—The time factor often occurs in making a gas analysis, *e. g.*, the gas has to be treated with the reagents for certain lengths of time to insure complete extraction, and the measuring burette should not be read before the water has run down the sides, or an error of several tenths per cent. will be made. The apparatus shown in sketch can be set for any number of minutes by shifting the rider, at the end of which time it sounds an alarm. This apparatus need not be limited to gas analysis, but can be used for other purposes."—H. A. ROESLER, Laclede Gas Light Company, St. Louis.

No. 5.—"*A Combustion Pipette.*—The ordinary method of determining the hydrogen and methane in a gas mixture is by exploding a small portion of the mixture with air or hydrogen. A better way is to burn all the mixture in a slow combustion apparatus. (See method of Dennis and Hopkins in 'Hempel's Gas Analysis,' p 293). The changes we have made are: (1) The addition of a water jacket to lessen the danger of cracking; (2) the platinum jet next the platinum wire to insure the ignition of the incoming gas; (3) the introduction of the gas into the oxygen, which does away with the danger of explosion that there is when the reverse method is used. The drawing explains itself."—H. A. ROESLER and D. WILSON, Laclede Gas Light Company, St. Louis.

AUTOMATIC TIMER FOR GAS ANALYSIS.

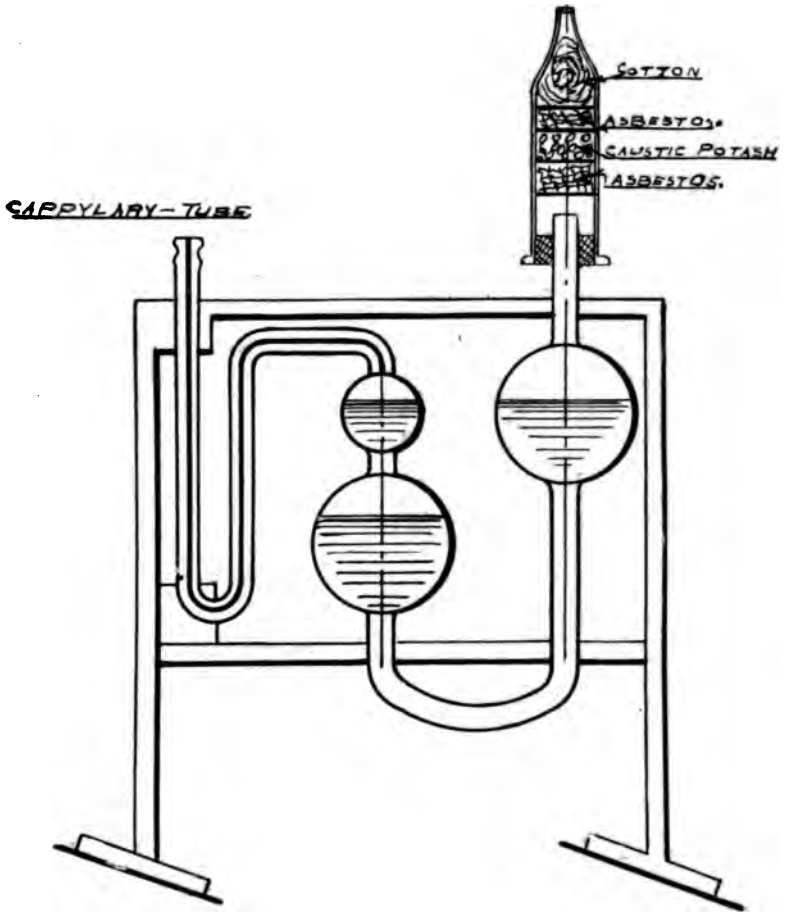


WRINKLE NO. 4.


GAS-INLET
CAPILLARY-TUBING
PLATINUM-TIP
GLASS TUBE WITH COPPER-WIRE
MERCURY
BRASS-SUPPORT

WRINKLE No. 5.

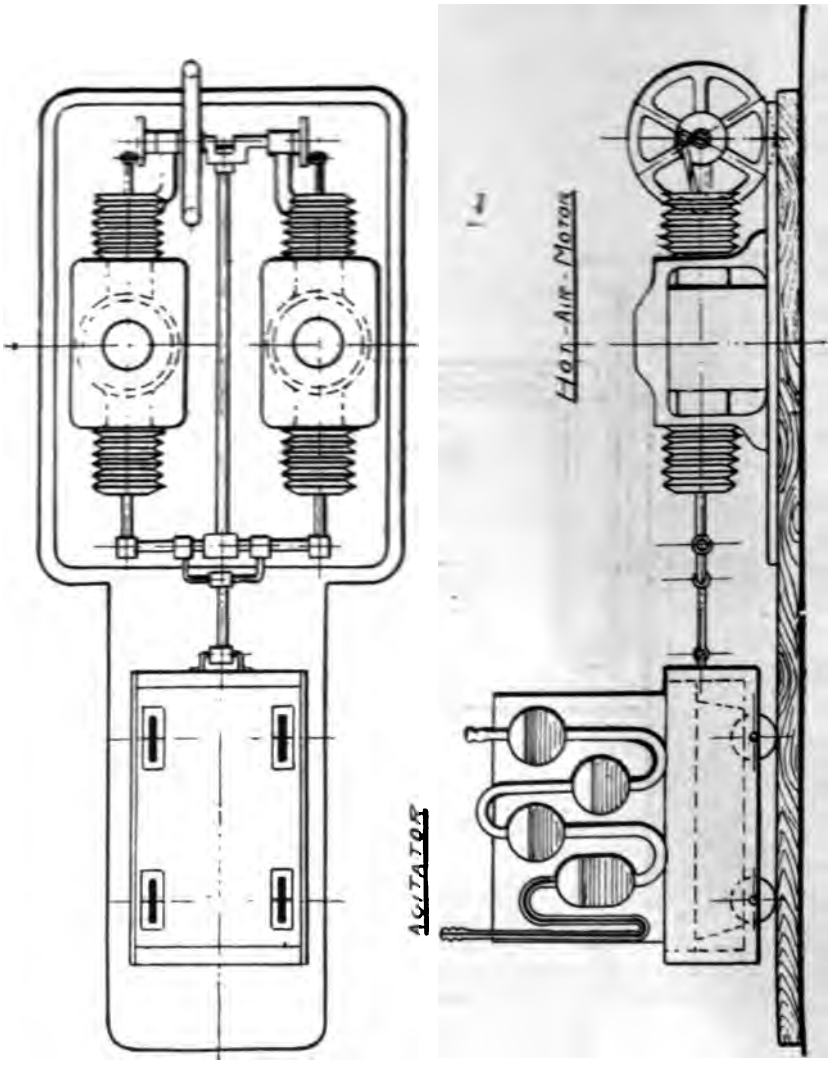
No. 6.—"*Fume Arrester for Sulphuric Acid Pipette.*—The attachment, as shown on drawing, is filled with alternate layers of stick potash and asbestos."—H. A. ROESLER, Laclede Gas Light Company, St. Louis.



FUME-EXTRACTOR.

WRINKLE No. 6.

No. 7.—*An Agitator.*—**When analyzing a gas with Hempel's apparatus, it is necessary to shake some of the pipettes for several minutes. This is a tiresome operation when done by hand, so**



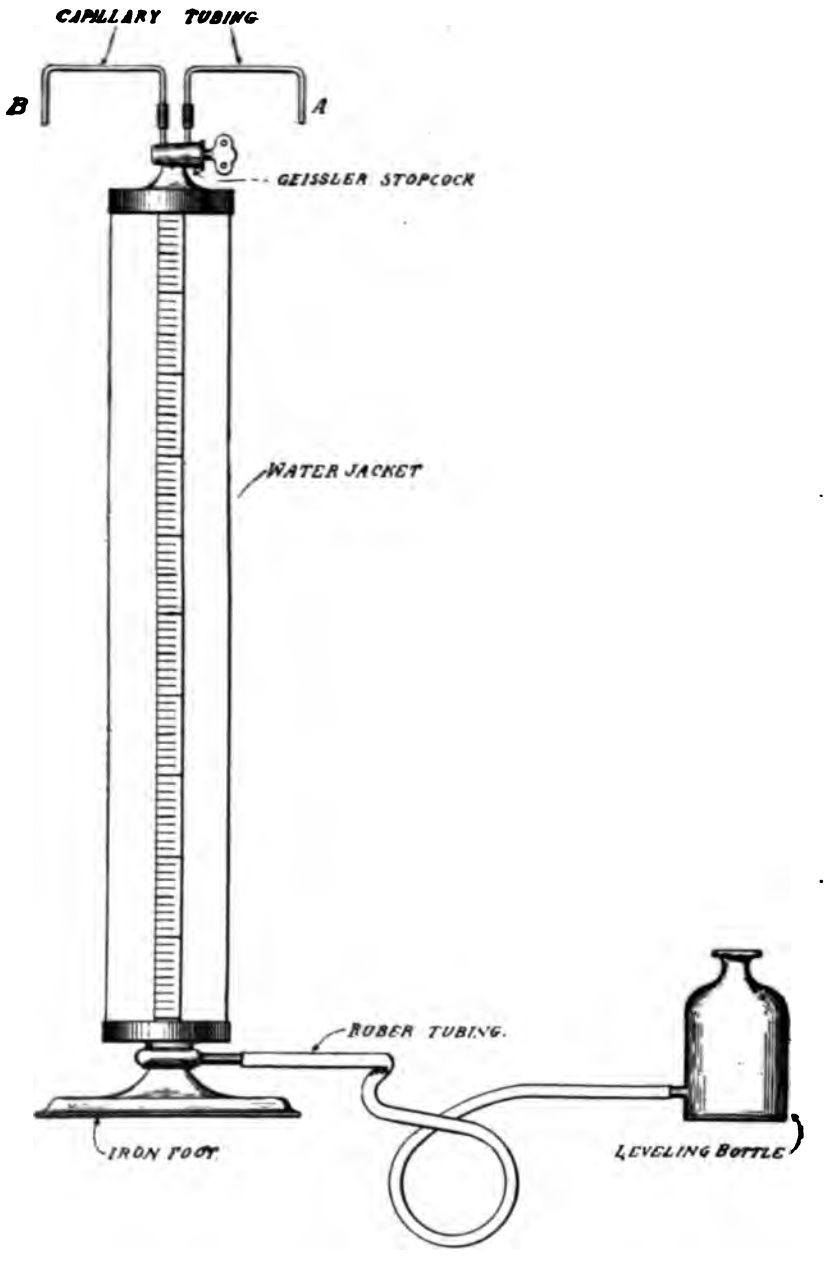
WRINKLE No. 7.

we have made the shaking apparatus as shown in sketch. A small wagon was built in which the pipettes to be shaken are set. This wagon is attached by a suitable arrangement to the piston

rods of the hot air motor. When the motor is running the wagon is moved backward and forward in this manner, shaking up the fluids in the pipettes. The hot air motor and the small wagon are mounted on a board so as to bring them on the same level. This is not a labor agitator, but has the reverse effect."—H. A. ROESLER and D. WILSON, Laclede Gas Light Company, St. Louis.

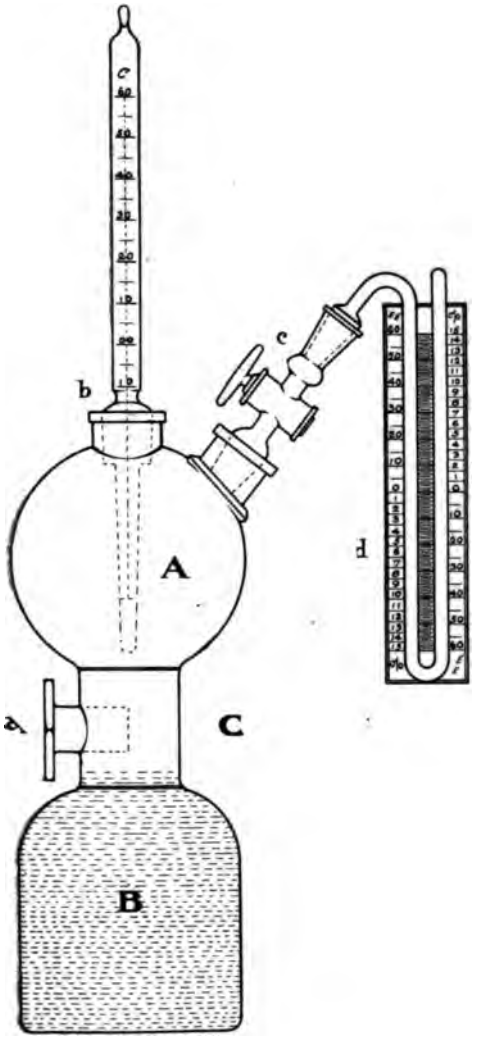
No. 8.—"*A Handy Burette for Use with Hempel's Apparatus.* This burette is fitted with a Geissler 3-way cock. At the beginning of a test the burette and capillary connection tubes are filled with water; 100 cc. of gas is drawn through capillary tube *A* and the first pipette connected to *B*. The gas is now driven over into the pipette, both capillaries filled with water and the second pipette connected to *A*. After the gas has been drawn back and measured, it is put into the second pipette and then the first reagent is pushed out of the capillary into its pipette, thus leaving the capillaries full of water, etc."—H. A. ROESLER, Laclede Gas Light Company, St. Louis.

No. 9.—"*Method of Extracting Sulphur Out of Purifying Material.*—Until now hydrocarbons with a boiling point below 100° C. and coal tar oils with a boiling point above 100° C. have been used to extract the sulphur out of the gas purifying material. To avoid the drawbacks of the above mentioned methods, there is a method of using coal oils with a boiling point of above 150° C. In this method of extraction the dissolving process takes place simultaneously with the melting of the S, which is very advantageous to the extraction. The extracted sulphur is free from any annoying compounds, and therefore shows its natural yellow color. Any traces of impurities can be easily removed by distillation. The material from which the sulphur is to be extracted and the coal oil are put together into a vat and heated to the boiling temperature of the dissolving element. This solution after boiling is drawn off into a second vat in which it is allowed to cool. The S deposits in a solid form and is separated from the dissolving medium by filtration. Any of the dissolving agents that may still remain in the extracted sulphur is extracted from the same by using benzene. The coal oil may also be regained by distillation."—G. S. HESSENBRUCH, Laclede Gas Light Company, St. Louis.


CAPILLARY TUBING
B
A
GEISSLER STOPCOCK
WATER JACKET
RUBER TUBING.
IRON FOOT
LEVELING BOTTLE

WRINKLE No. 8.

No. 10.—"*Method of Determining the Percentage of Carbon Dioxide in Furnace and Illuminating Gases.*—The accompanying sketch showing apparatus designed by Dr. W. Oechelhaeuser is well adapted for commercial and retort house use, and as can be seen it consists of two pear shaped glass globes *A* and *B* connected by a narrow neck *C*.



APPARATUS ~ CO_2 DETERMINATION

WRINKLE NO. 10.

"There is an air tight glass stopper '*a*' in this contracted part and similar openings '*b*' and '*c*' are attached to the upper vessel.

"Through '*b*' a thermometer is snugly inserted with its bulb in the vessel *A*. The stopper '*c*' is provided with a simple stop cock, which connects by a conical glass connection to the siphon pressure gauge '*d*.'

"Imagine vessel *B* filled with a liquid that absorbs only CO_2 in furnace or illuminating gases, as KOH, or Na OH; and *A* filled with the gas under examination having the openings '*a*,' '*b*' and '*c*' closed.

Now the liquid will absorb the CO_2 present in the gas, particularly if the apparatus is turned

upside down so that the gas must pass into *B* and then back into *A*. As a result of this absorption a partial vacuum will be created in the interior of the apparatus, the extent of which will be in exact proportion to the amount of CO_2 absorbed, and the amount of which can be observed by attaching the gauge '*d*' and opening the cock '*c*.'

"If the gas had consisted of pure CO_2, this would have been entirely absorbed, and a complete vacuum would have resulted in *A*. As a result of this the mercury column in the gauge would have risen to a height equal to that of the barometer. Had only half the gas been CO_2 the gauge would only have risen to one-half of the height of the barometer. Had only one-twelfth of gas been CO_2 the gauge would only have risen to one-twelfth the height of the barometer.

"Therefore according to Marioote's or Boyle's law: 'That the volume of a given quantity of gas is inversely as the pressure,' it is very easy to compute the amount of CO_2 in the gas. Suppose the barometer to be -b-lines high and the gauge-b,-lines, the percentage of CO_2 is expressed by 100xb, b.

"With an average barometer of 30 inches or 7.60 m.m. would denote 1 per cent. of CO_2. Several corrections however are necessary for this mode of reckoning.

"First the space *A* is never void of air and contains moisture which affects the barometer reading. The variation due to this cause, however, is so trifling that it may be neglected.

"As a rule the temperature of the gas and the liquid is not the same, so that during the absorption the temperature of the liquid increases. It is therefore necessary to take the temperature of the gas before and after the test in order to reduce the volumes of even temperatures.

"For every change of 1° in temperature the gas changes .0036 or about ⅓ per cent.; therefore if the temperature of the gas after the absorption is higher—for every degree of change ⅓ per cent. of CO_2 must be added, for on account of the increased heat more pressure bears down on the mercury and makes the vacuum appear less than by even temperature before and after the absorption.

"Vice versa for every fall of 1° ⅓ per cent. is to be counted off.

"In using this apparatus the follow must be observed: All

stoppers and cocks must be made air tight by applying a little vaseline or tallow with the finger.

"Changes of temperature must be avoided, and the apparatus filled with its liquid should be placed in the room where the tests are to be made for some time before beginning, so that the apparatus reaches the same temperature as the room. Do not handle the apparatus, and particularly the vessel *A* with the bare hand; but use a piece of thick woolen cloth with which to hold it.

"To prepare the absorbing solution dissolve ½ ounce or 16 grams (KOH or Na OH) caustic potash or caustic soda in enough distilled water to fill the apparatus to the neck.

"To better understand the handling a determination of CO_2 with the apparatus will be described. After the apparatus has stood for some time in the room where the experiment is to be made, so that the fluid has arrived at an even temperature with the room, clean the stoppers and cock '*c*' carefully, seeing that its opening is clear, and coat with vaseline or tallow. Dry the bulb of the thermometer.

"Now open the cock '*c*' and slip a rubber hose, connected with the supply of gas over the connection for the siphon gauge. After placing the thermometer in '*b*' allow the gas to enter the vessel *A*, and escape from the opening '*a*' so that it will gradually fill the apparatus. A hose connection to the suction of a rubber foot pump can be made to '*a*' by means of a cock, if necessary.

"After about one-tenth of a cubic foot of gas has passed the upper vessel will be filled with gas alone, it is well to have a large amount of gas pass quickly through *A*, however, before a sample is taken. The stopper '*a*' can now be put in, or in case a foot pump is used close the cock to same, and if the cock '*c*' is immediately closed the pressure in the apparatus due to the entering gas can be neglected. Remove the rubber tube from '*c*' and note the temperature of the gas at the thermometer. Now hold the apparatus at the narrow point *C* in the left hand by means of the woolen cloth, and turn it upside down, at the same time holding the thermometer steady with a finger tip of the right hand, and the gas will rise into vessel *B*. Repeat the manipulation a few times (about 10 suffices for 4 per cent. carbon dioxide) and the CO_2 will be absorbed.

"Place the apparatus on a table, attach the siphon pressure gauge to '*c*' tightly, open the cock '*c*' carefully, read the gauge

and note the temperature, taking care not to approach the apparatus too closely with the hand or body. After two minutes read the full height of the quicksilver column and temperature again, then the percentage of CO_2 can be easily computed according to the data given above.

"For convenience the large divisions on the scale of the manometer are 7.6 m.m. apart, which with an average height of barometer of 760 m.m. denotes 1 per cent. CO_2 as we have seen above.

"If the experiment is made at a time when the barometer is near 760 m.m., 20 m.m. difference only denotes a mistake of .027 per cent., so that the influence of the atmospheric pressure, as a rule, may be neglected, and if the temperature remains the same the percentage of CO_2 can be read directly from the scale of the gauge.

"If, on the other hand, the temperature of the gas before the absorption was 16°, and after 18½°, or 2½° higher, and the gauge read 1⅙ per cent., the real amount of CO_2 present would have been ⅔ per cent. ($2\frac{1}{2} \times \frac{1}{3}$)—2 per cent.

"But if the temperature of the gas had been 2½° less after the absorption the real amount of CO_2 could have been 2 per cent.

"There is one more consideration, the fluid not only absorbs CO_2, but other gases and large mistakes may arise thereby if the solution is not saturated with these other gases before testing. It is therefore necessary before making a test to fill the vessel *A* with gas, and by tipping 10 or 12 times the solution is saturated with all other gases in the mixture undergoing test. If this is repeated a few times the gas and liquid can be brought to the same temperature in case the difference was not too great.

"It is always advisable to make several determinations in order to check the correctness of the results.

"Testing the carbon dioxide in gas is not only of interest but also of great importance in judging the operation of regenerative furnaces, various kinds of coal, and solving noticeable differences in the candle power of illuminating gas, which is markedly affected by the amount of CO_2 present.

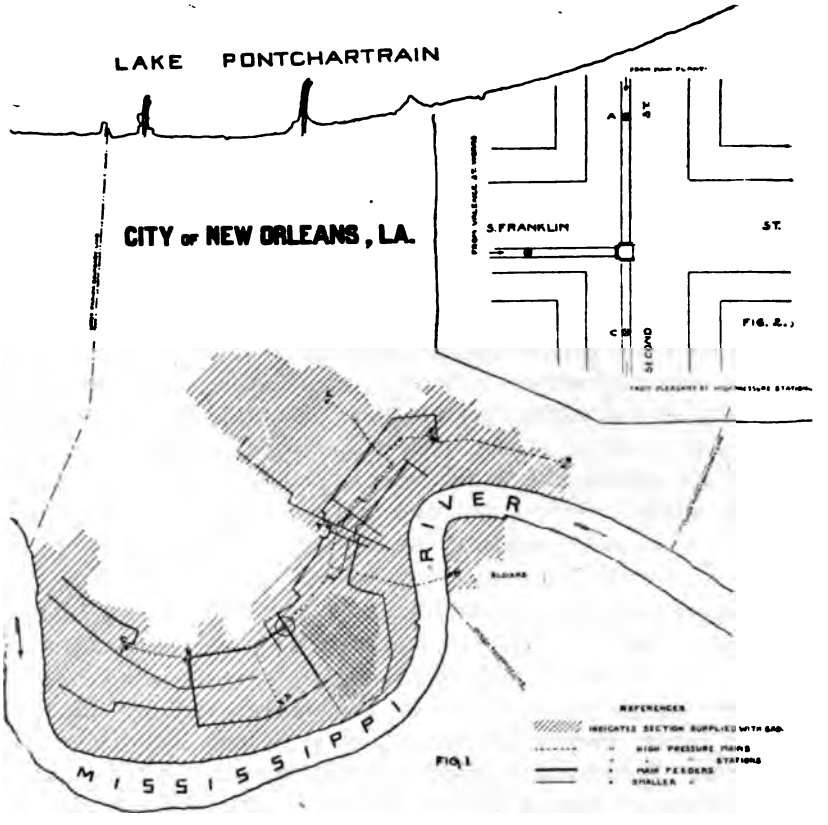
"Every per cent. of carbon dioxide decreases the illuminating power of an ordinary flame consuming 5 cubic feet per hour at least 1 candle power.

"As a precaution before putting the apparatus away the open-

ings should be dried, recoated with grease and closed. If this is observed one filling will last for 40 or 50 tests."—W. E. STEINWEDELL, Cleveland, O.

DISTRIBUTION.

No. 1.—"*Method of Determining Relative Quantity of Flow in the Various Branches of a Distribution System.*—The attached cut



WRINKLE NO. 1.

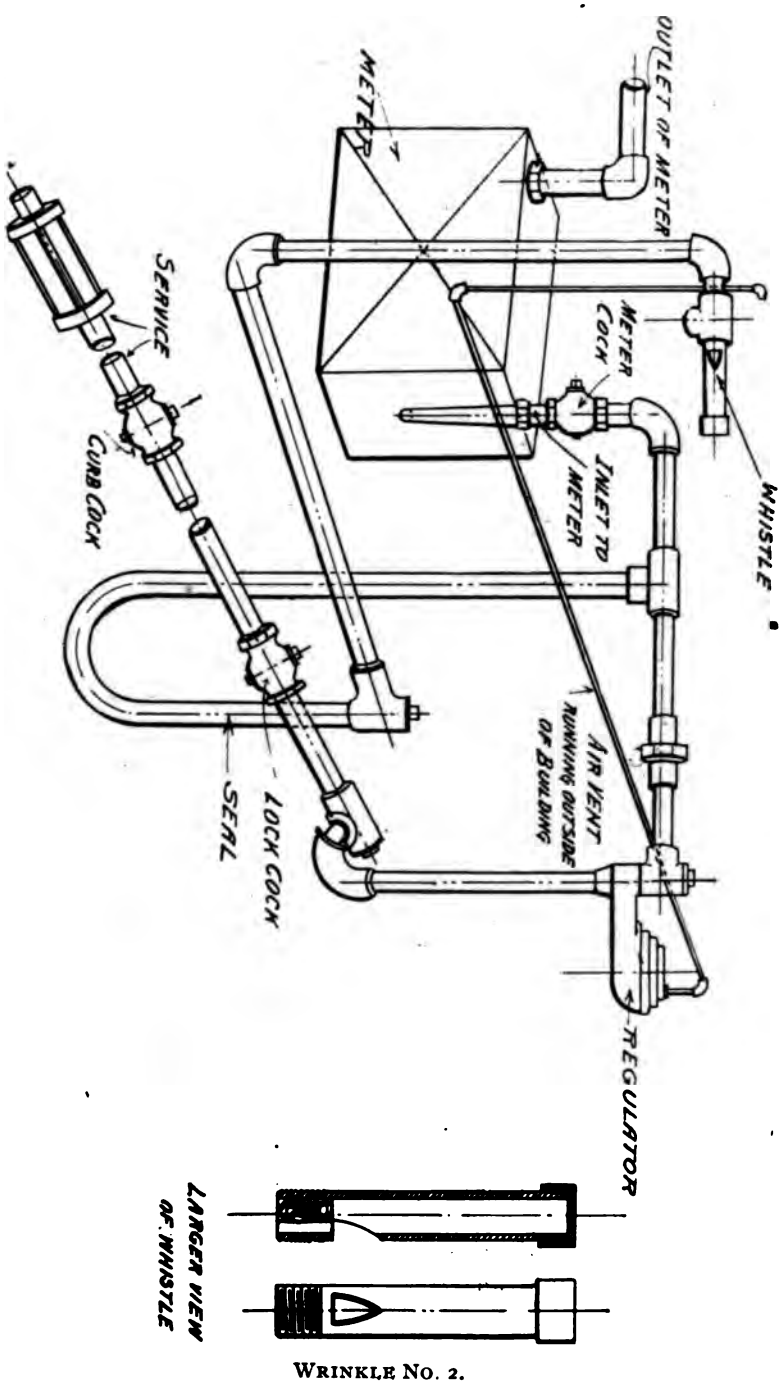
shows the general lay of the city of New Orleans, La., our main distributing lines, the high pressure lines and the high pressure stations.

"The problem which I was forced to solve was the territory double lined between Stations *A*, *D* and *H*, referring to Fig. 1.

At a point inclosed in a circle are mains which can be supplied from Station *A*, which is the works, *B* which is a holder, or *D* which is a high pressure governor. Desiring to extend our re-inforcing lines into the territory which is double lined I naturally wanted to get in the shortest run of pipe, but on the other hand I wanted to draw the supply of gas from the holder at the works rather than from a station supplied by the high pressure system for obvious reasons. Referring to Fig. 2: I had gas stoppers inserted at *A*, *B* and *C*. By expanding the stoppers at either place and taking pressures on both sides of the stopper, I was able to determine just the value of the flow of gas coming from these three different directions. Having finally demonstrated the fact that there was an ample flow coming from the main plant, it was a simple question to lay out a re-enforcing line to go into the territory suffering from low pressure."—THOS. D. MILLER, New Orleans, La.

No. 2.—"*Safety Whistle on High Pressure Service Connections.* At the point marked *W* a whistle is placed so that, in case the governor is not working and allowing the gas to force the oil out of the seal, the whistle will commence blowing and continue blowing until conditions are remedied. This whistle is made out of a short piece of ¾-inch pipe with a cap on one end and a notch and wooden plug at the other. This is an additional safeguard against accident and costs very little."—W. S. REGER, Laclede Gas Light Company, St. Louis.

No. 3.—"*Portable Air Compressor.*—Accompanying is a photograph of the apparatus used by the Laclede Gas Light Company, St. Louis, for testing both high and low pressure mains. It consists of a Fairbanks-Morse, 6-horse power vertical gasoline engine, a 6 by 6 Star air compressor, made by the St. Louis Steam Engine Company, and a 24-inch by 5-inch air receiver. Mounted on a truck it is easily moved along the line, or from one job to another. This feature makes the use of the apparatus practical for caulking joints as well as testing. The engine will furnish 125 pounds pressure at a very little cost, as the wagon is not shifted often on a long run of pipe, and can be run by a 'handy' man. The total cost of an outfit of this kind, without a wagon, runs about $550."—J. D. VON MAUR, Laclede Gas Light Company, St. Louis, Mo.


OUTLET OF METER
METER
METER COCK
INLET TO METER
WHISTLE
SERVICE
CURB COCK
AIR VENT RUNNING OUTSIDE OF BUILDING
LOCK COCK
SEAL
REGULATOR
LARGER VIEW OF WHISTLE

WRINKLE NO. 2.

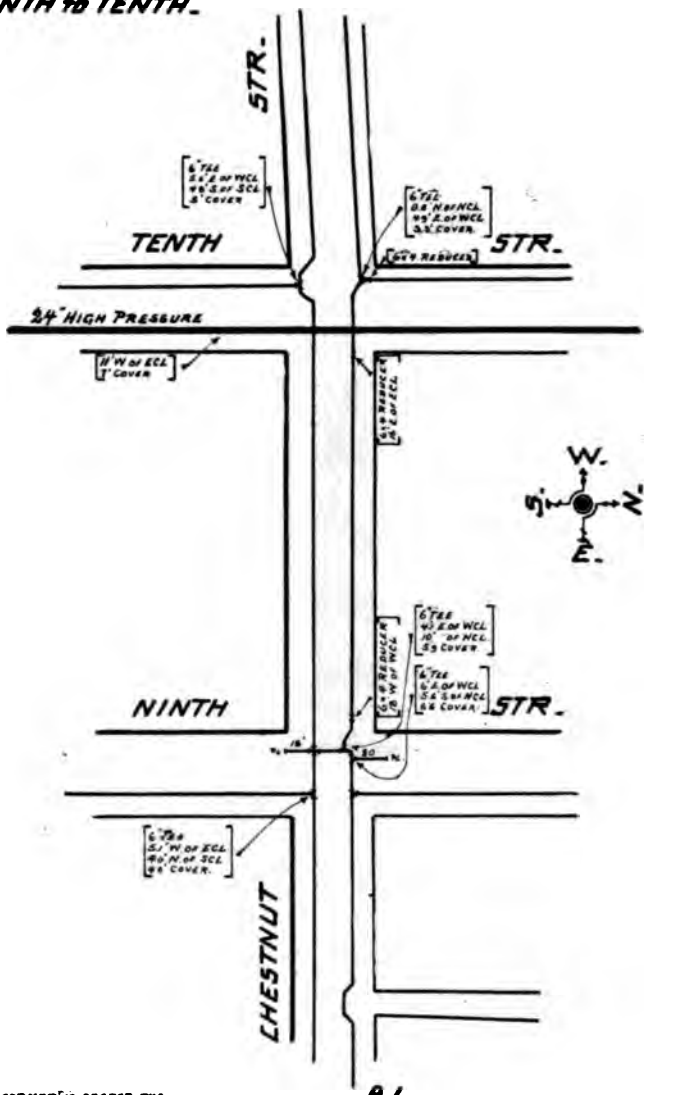
No. 4.—"*Sketches with Main Orders.*—Whenever any main work is to be executed an order is issued giving the foreman his instructions. To make it easier for the foreman, and to give him a more intelligent idea of his work, a sketch is attached to this order showing the actual conditions as they exist at the time, giving him all the mains and locations on the street to be worked on, and also all mains crossing this street. As many details are shown as possible without making the sketch too complicated. It has been found to be very useful and a great saver in time, money and explanations."—G. S. HASSENBRUCH, Laclede Gas Light Company, St. Louis, Mo.

WRINKLE NO. 3.

No. 5—"*A High Pressure Seal.*—To prevent trouble on the high pressure lines, due to excessive pressure, a seal is connected to the outlet of the blower at the central pumping station. The seal shown in sketch is a steel tank 6 feet in diameter and 17 inches by 4¾ feet in depth, having at the top two openings, one *A* connecting a 16-inch line from the blower, and the other *B* connecting a 16-inch line to the inlet of the holder. From the opening *A*, a 16-inch pipe extends to within 18 inches of the bottom of the tank, and rests on a substantial support. The

THE LACLEDE GAS LIGHT COMPANY.

CHESTNUT STREET. ST LOUIS. FEB. 9. 1905.
NINTH TO TENTH.

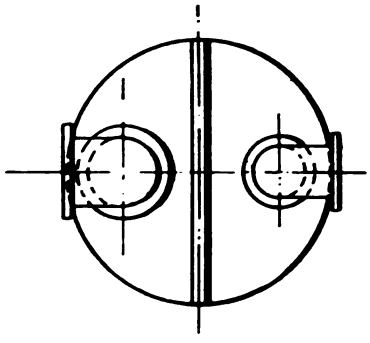


IN THIS CORNER IS STATED THE WORK TO BE DONE, i.e. LAYING OF MAIN, SERVICE OVERHAULING, REPAIRING, ETC.

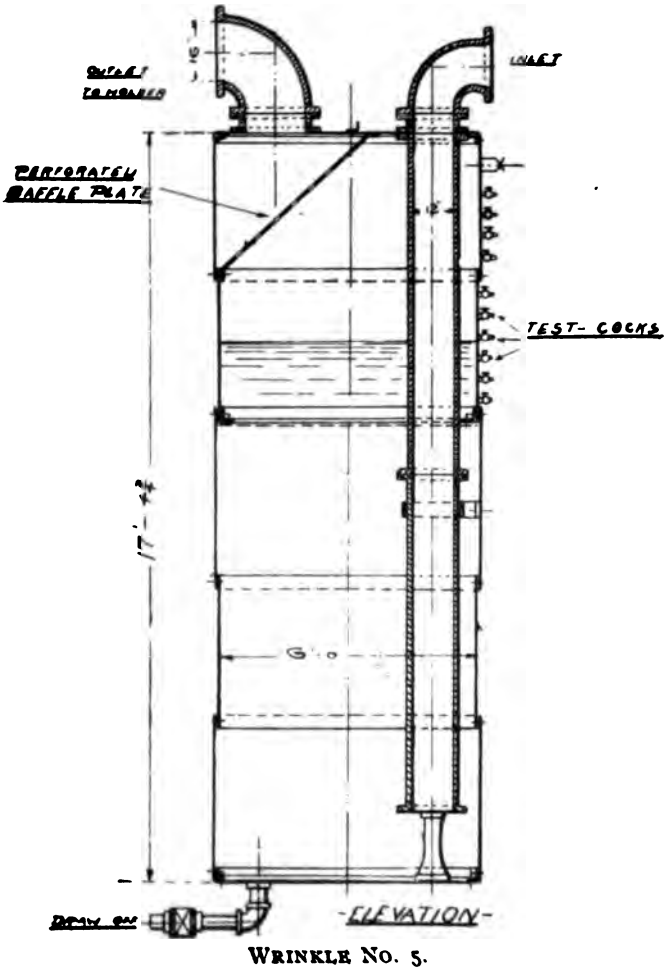
SKETCHED BY A.L.

SUP'T.

WRINKLE NO. 4.



-PLAN



WRINKLE No. 5.

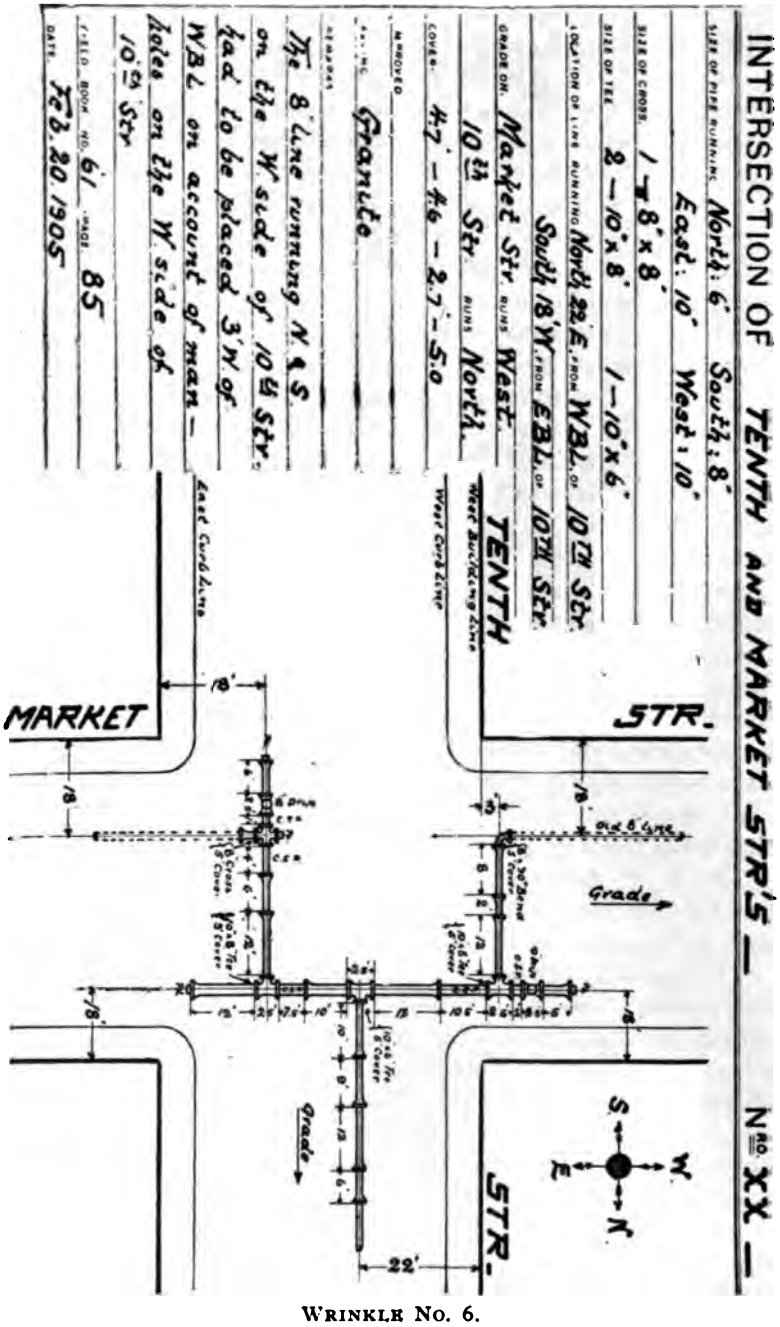
tank is filled with water to a point above the bottom of the inlet pipe, so as to cause a water column equaling 5 pounds per square inch pressure. This water is sufficient to resist a pressure of 5 pounds, which is the maximum the lines are designed to carry. Should the pressure exceed 5 pounds the seal will blow and the gas escape through outlet *B* to the holder and be repumped. A baffleplate is placed at an angle of 45° across opening at *B* to prevent foam, caused by the bubbling of escaping gas, to pass through into the pipe. The tank is provided with the necessary connections and fittings for draining."—By the EDITOR.

No. 6.—"*Intersection Cards.*—It is of great value to the street department to be able to give the foreman of a main gang the exact location of fittings, etc., at intersections of streets. To keep a separate and an up-to-date record of the mains, fittings, etc., at such intersections, a card system was gotten out. The accompanying illustration shows such a card. All locations are given and any special point can be dug up without disturbing any more of the street than is absolutely necessary. The cards are 8 inches by 5 inches, and they are filed alphabetically. Before starting to dig any desired location can be given the foreman."—GEORGE S. HESSENBRUCH, St. Louis, Mo.

No. 7.—"*A Pitot Tube and Pipe Bender.*—The Pitot tubes, as illustrated in accompanying sketch, are of ¼-inch pipe, and made by ourselves. We made a tube bending apparatus which enables us to bend a pipe at exactly the same angle, and find that tubes made in this way give consistent results."—E. H. EARNSHAW, Cincinnati Gas and Electric Company.

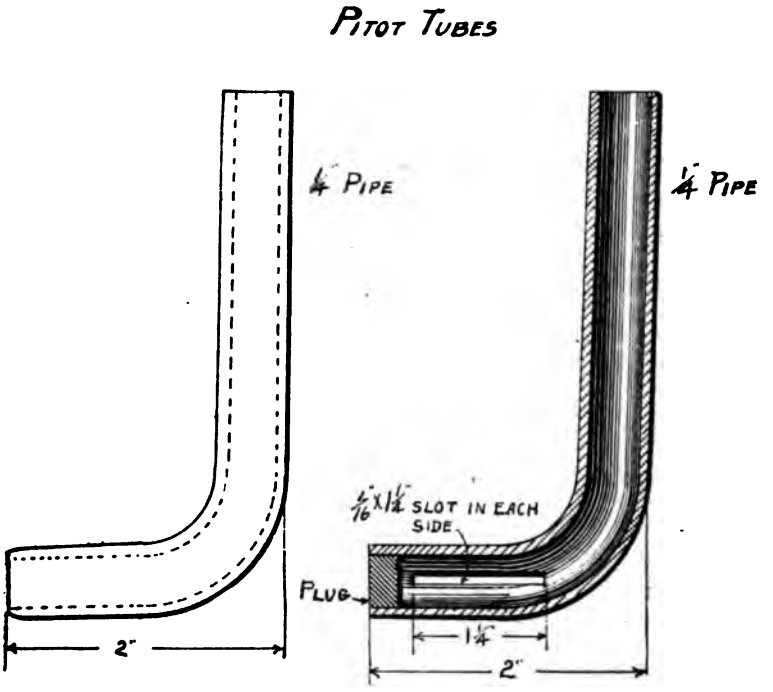
"No. 8.—"*Method of Installing a High Pressure Service.*—Those familiar with the distribution of gas under high pressure would perhaps be interested in the following:

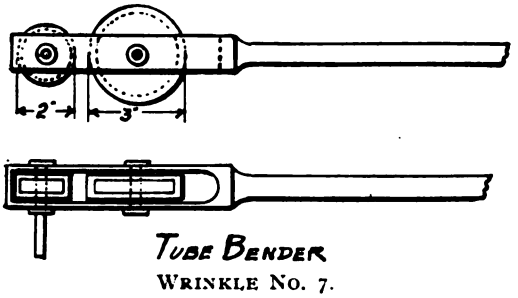
"To install a high pressure service, it has been necessary at the main to use a saddle, a corporation cock and 2 street elbows, raising the service some 8 or 9 inches above the main and making a connection that was more or less weak and one that was apt to break in cold weather. At the house end a complicated arrangement of pipe and fittings was required to properly connect up the governor and seal, and as this usually lay close to the meter considerable room was taken up. This method of connecting was not only unsightly but quite objectionable, particularly so if the service ran directly into the kitchen or living room, as is frequently the case where no basement exists.


INTERSECTION OF TENTH AND MARKET STR'S —
No. XX —
SIZE OF PIPE RUNNING North: 6" South: 8"
East: 10" West: 10"
SIZE OF CROSS 1 — 8" x 8"
SIZE OF TEE 2 — 10" x 8" 1 — 10" x 6"
LOCATION OF LINE RUNNING North 22 E. FROM WBL. OF 10th Str.
South 18' W. FROM EBL. OF 10th Str.
GRADE ON Market Str. RUNS West.
10th Str. RUNS North.
COVER 4.7' — 4.6 — 2.7' — 5.0
REMOVED
GRADE Granite
REMARKS The 8" Line running N. & S.
on the W. side of 10th Str.
had to be placed 3' W. of
WBL on account of man —
holes on the W. side of
10th Str
FIELD BOOK NO. 61 PAGE 85
DATE Feb. 20. 1905
MARKET STR.
TENTH STR.
East Curb Line
West Building Zone
West Curb Line
Grade
Grade
22'
N.
S.
E.
W.

WRINKLE NO. 6.

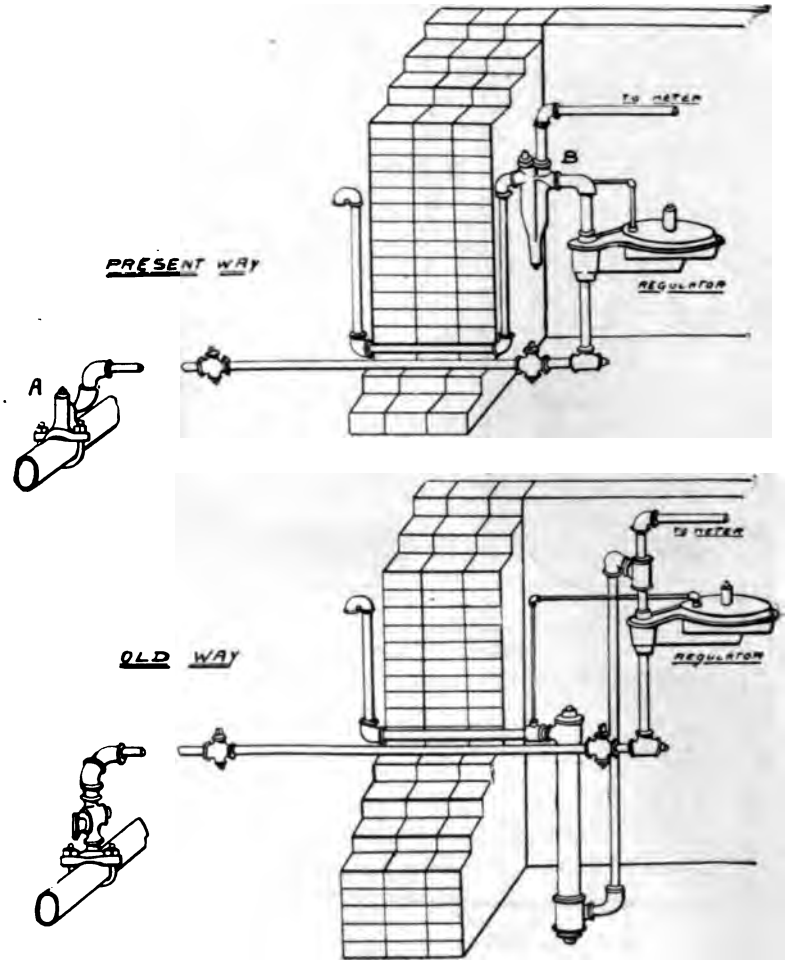
"The combination saddle and tee *A* permitting of a shorter and more rigid connection at the main, and the seal *B*, small and compact, because it is made to hold mercury instead of oil, are the only novelties in this wrinkle but a comparison of the two





WRINKLE NO. 7.

drawings will show at a glance the superiority and neatness of one over the other. The opening at the top of the tee *A* is for the purpose of inserting a wooden plug so that the gas can be shut off temporarily until the curb cock is reached, when it is



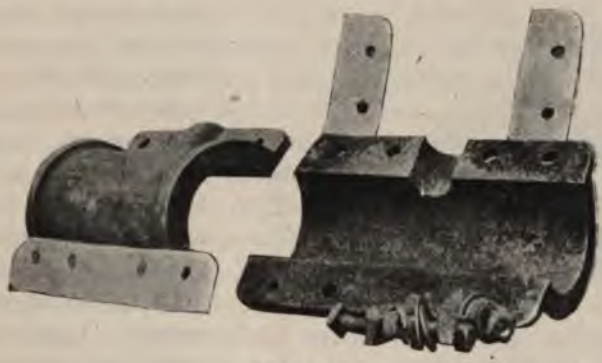
WRINKLE No. 8.

within and the plug replaced. In both drawings the services are made to appear as if they extended a foot or more in the basement, but this was done merely to show a little more clearly the position of governor and seal. In practice the whole connection

is twisted and crowded into a more compact mass. so that it does not occupy as much room as indicated.

"Both the saddle and tee, I am told, were designed by Mr. Johnson, formerly of Hammond, Ind."—LESTER F. PRICE, North Shore Gas Company, Highland, Ill.

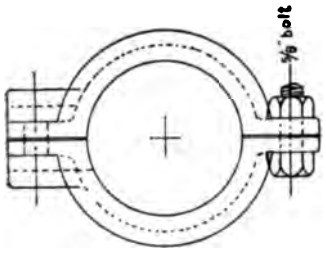
No. 9.—"*Special Split Sleeve.*—Prior to the spring of 1903 service taps in St. Louis were made into the side of the main, and the hole in nearly every case was tapped the same size as the service. The swing joint or street tee and ell was not used on



Cut No. 1.

Cut No. 2.

services in St. Louis prior to 1903. We, therefore, have found in our extensive overhauling hundreds of good 1¼-inch services connected into the side of 4-inch mains with 1¼-inch tap. Where we find such service connections it has been our custom to cut the service off, put a split sleeve on the main, cut a new thread on the cut end of the service and re-connect with a long screw. Where a broken main or a defective tap was found the same process was gone through with. Aside from the inconvenience to the customer, whose supply we were obliged to cut off from 1 to



Material Cast Iron
Fig 3

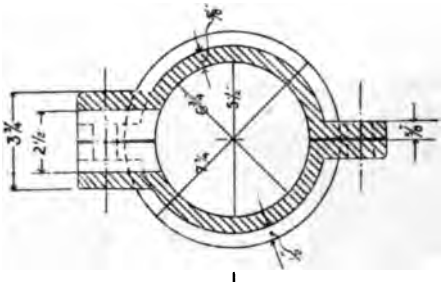
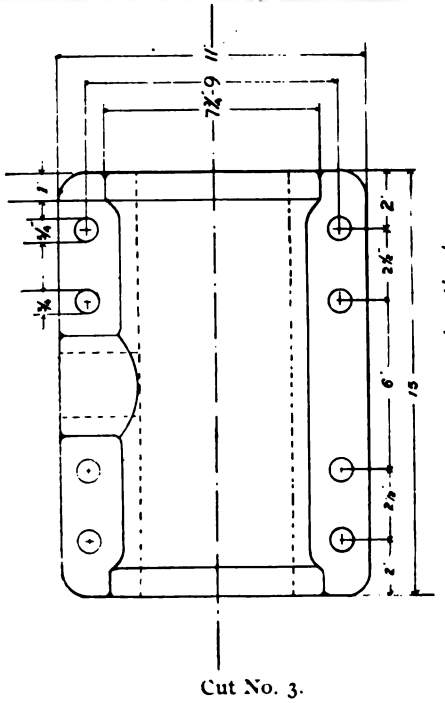


Fig. 2



Two such halves joined together by 6-⅝ bolts & separated by a lead gasket.
Fig 1

Cut No. 3.
WRINKLE No. 9.

2 hours, considerable labor was expended. You can readily see that with this sleeve a broken main at a service tap can be repaired without cutting off the supply in about 15 minutes after the trench is dug. In the same way a main can be strengthened where the tap has been made too large. Cut No. 1 shows a part of such a sleeve unassembled, and cut No. 2 shows a 4-inch broken main repaired without disconnecting the service. The joints in the photo are made of cement. Lead may be used if so desired. The boss is made large enough to admit the making of a cement or lead joint around the service pipe. Cut No. 3 shows the details of such a sleeve. The saving in labor in using such a sleeve is considerable. The cost of putting in a sleeve as above described in a dirt street on a 4-inch main, the labor was $1.66, whereas under the same conditions, but using an ordinary 4-inch sleeve tapped to 1¼ inches, necessitating cutting the service and reconnecting

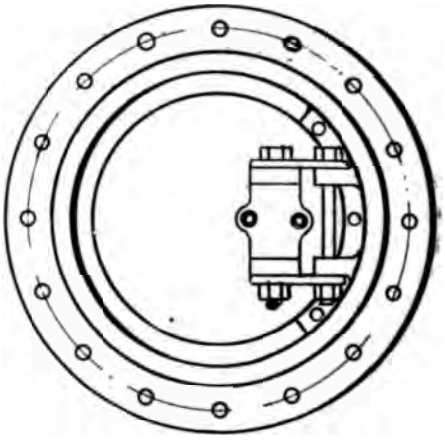
service after sleeve is put on main, the labor is $3.27, making a net saving of $1.61."—P. H. GIBBONS, Laclede Gas Light Company, St. Louis, Mo.

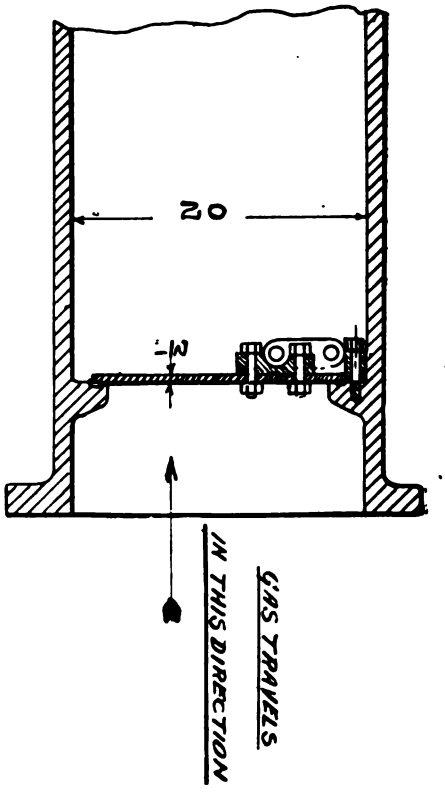
No. 10.—"*Folding Main Maps.*—It is of great advantage to be able at all times to tell what mains are on certain streets, and on what side of the street they are located, without having to refer to the regular office records. This is especially true for the superintendents and district superintendents. For this purpose an ordinary city map may be adopted and be cut into equal sections mounting all these sections on a linen back so that they can be folded together, and binding it in a heavy protecting cover. The mains are inserted in the drafting room and the map is posted once every two weeks. These maps are gotten out for the gas department as well as the electric department, and are of size that they can be put in one's coat pocket."--GEORGE S. HESSENBRUCH, Laclede Gas Light Company, St. Louis.

No. 11.—*Check Valve for Use on High Pressure Blower.*—This check valve elbow was designed to preclude the possibility of the pressure in the mains backing up into and reversing the blower and blowing seal, as actually occurred. The valve plate hangs on a line hanger which is bolted to the face of the special by means of a supplemental suspension link, which allows the valve plate to assume a parallel position, and under all conditions make a tight fit against valve seat. These are used at the outlet of the blowers pumping into the 5-pound, high pressure system at St. Louis. It is a good general rule to use check valves on the outlets of all compressors."—J. D. VON MAUR, Laclede Gas Light Company, St. Louis, Mo.

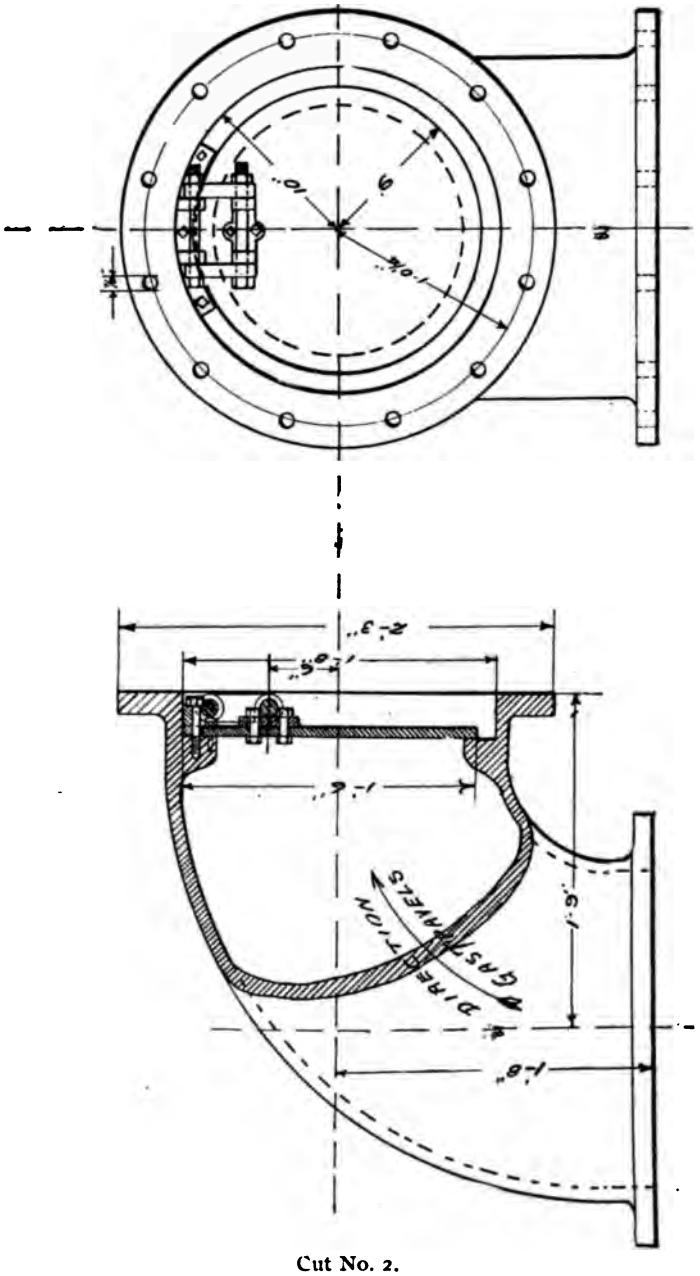
No. 12.—"*Simple Iron Connections for Illuminating and Fuel Gas Meters.*—The accompanying sketch shows a desirable and simple method of iron connections for gas meters used by the Laclede Gas Light Company, St. Louis, Mo.

"This method has been found exceedingly satisfactory. It is very accessible, and the meters can be taken off and put on with very little trouble, and without at anytime disturbing any of the pipe which remains in the house. At the connection of the service there is a tee plugged on one end which allows an easy access for wiring the services or for using alcohol during the winter time. From this connection there is a riser which leads to the header through a tee. This tee is also plugged on one end

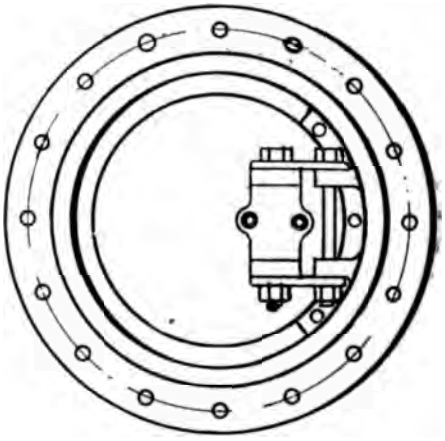


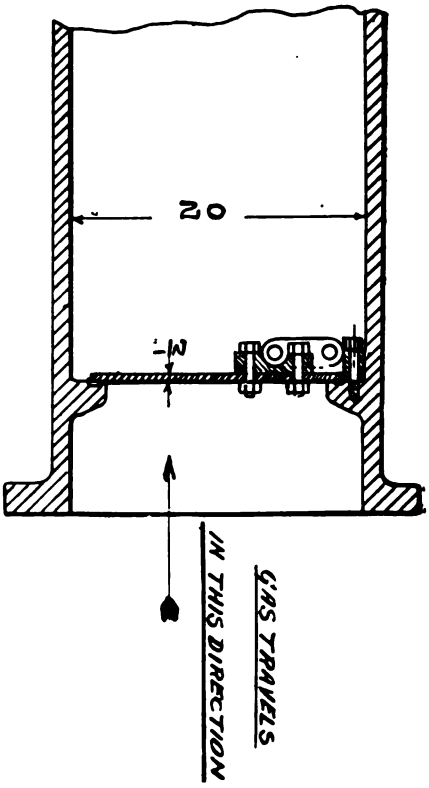


Cut No. 1
WRINKLE N(

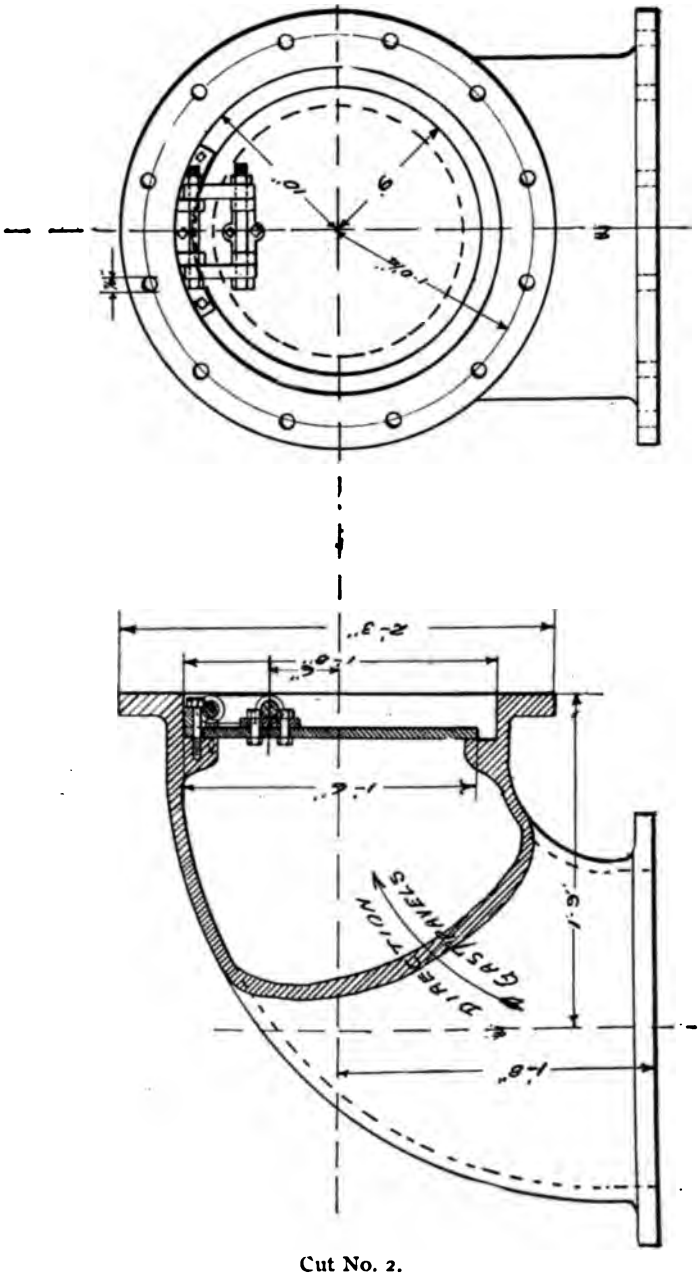


Cut No. 2.
WRINKLE NO. 11.

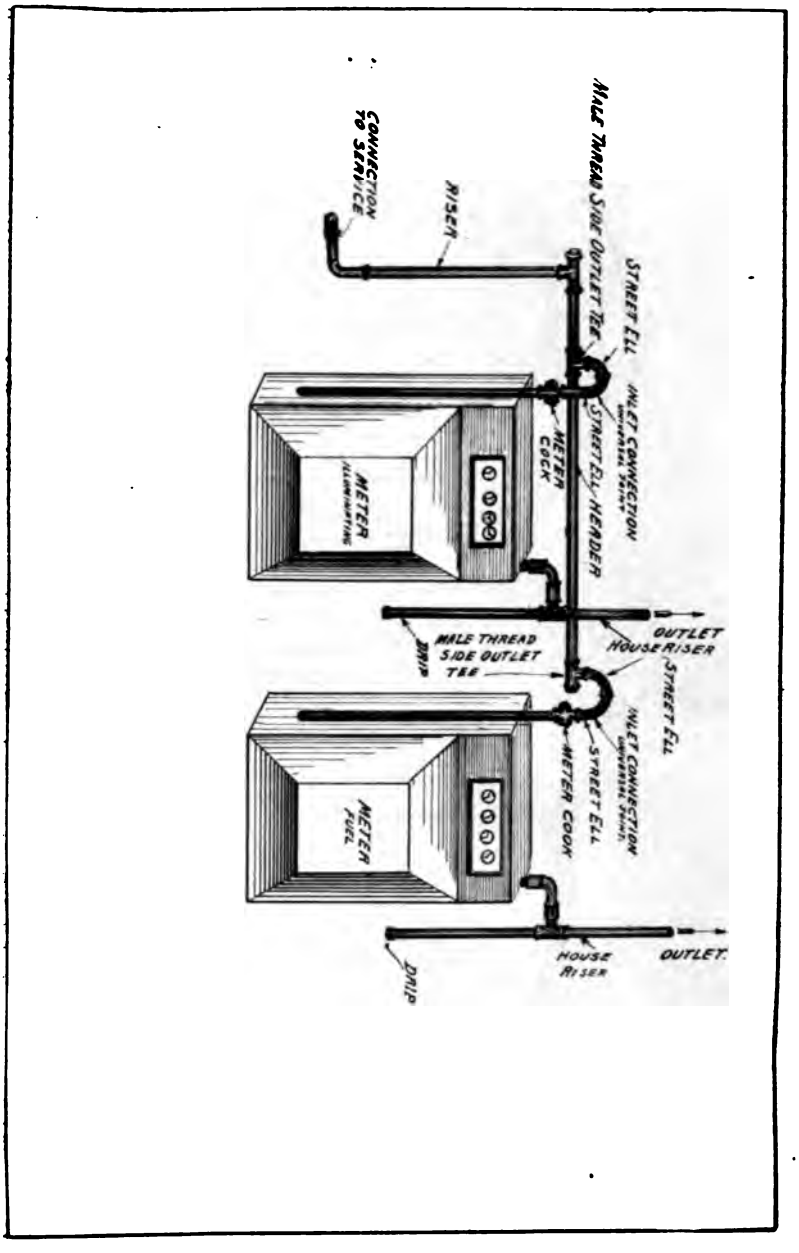




Cut No. 1.
WRINKLE NO



Cut No. 2.
WRINKLE No. 11.



WRINKLE NO. 12.

for accessibility and cleaning purposes. The inlet of the meter itself is connected to the header by means of a male thread, side outlet tee and two regular street ells, thus permitting considerable flexibility in both directions. The meter cock is a lock cock and there are also locks over both meter unions, in this way preventing anybody from closing or opening this cock at will or disconnecting the meter. The outlet of the meter is connected by means of an ell and tee to the house riser. This house riser extends down about 8 or 10 inches below the connections of the tee, forming in this way a drip for any moisture or other matter which may form in the pipe and drip down, preventing it from getting inside of the meter itself for a much longer time than by the ordinary method.

"The arrangement of connecting meters in this manner also has the advantage of permitting the extension of the header and connecting as many meters to this header and piping as are wanted without having the meters bunched, or having an unsightly arrangement where the meters are installed, and at the same time allowing the removal of any one meter without disturbing the remainder.

"The Laclede Gas Light Company is using this arrangement of installing meters throughout, and is rapidly changing all the old lead meter connections to this style."—W. S. REGER, Laclede Gas Light Company, St. Louis, Mo.

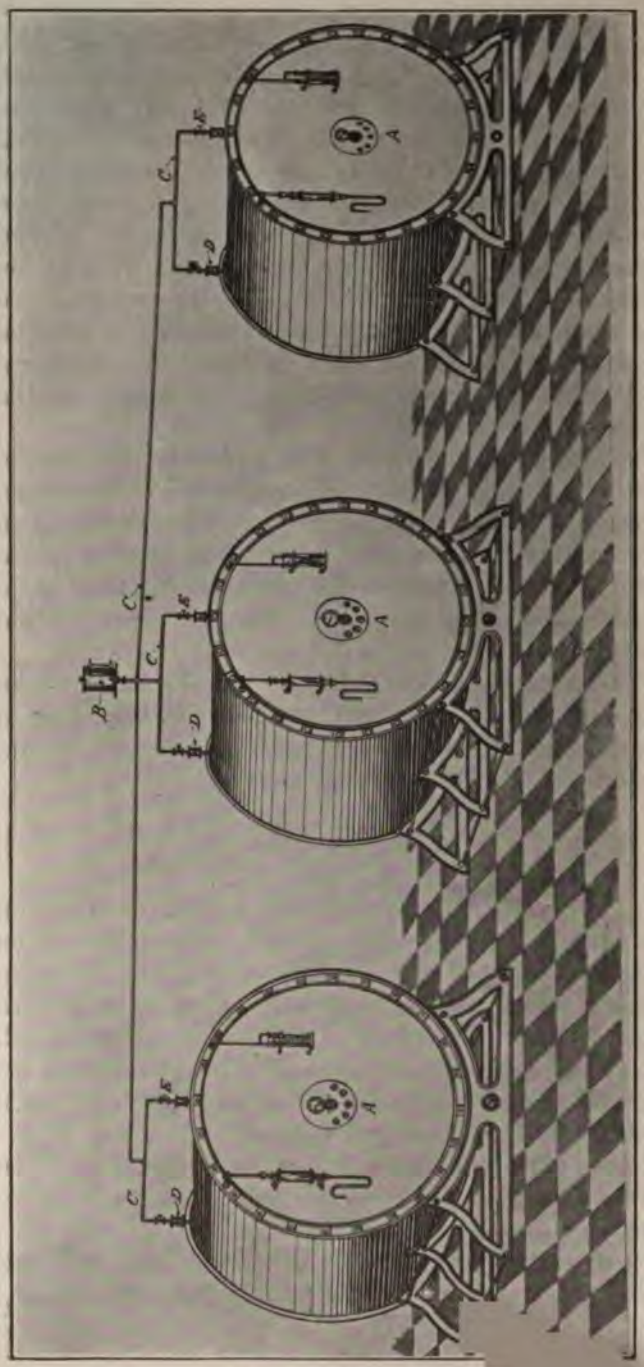
METER WORK.

No. 1.—"*Oiling Device for Station Meters.*—The diagram shows a very complete method of oiling station meters used at Station A works of the Laclede Gas Light Company: *A* represents station meters to be oiled; B, a 20-gallon oil tank supported among roof trusses; *C*, feed pipes supplying oil cups *D*; *D*, oil cups are connected to shaft bearings inside of meters; *E*, stopcocks on feed pipes for filling oil cups."—J. O. JONES, Laclede Gas Light Company, St. Louis.

No. 2.—"*How to Calibrate a Gas Meter Prover by Means of a Standard Cubic Foot Bottle.*—Place cubic foot bottle in a room suitable to maintain a constant pressure.

"Set up meter prover level by the side of cubic foot bottle.

"The prover bell must be perfectly balanced, either by a



WRINKLE NO. 1.

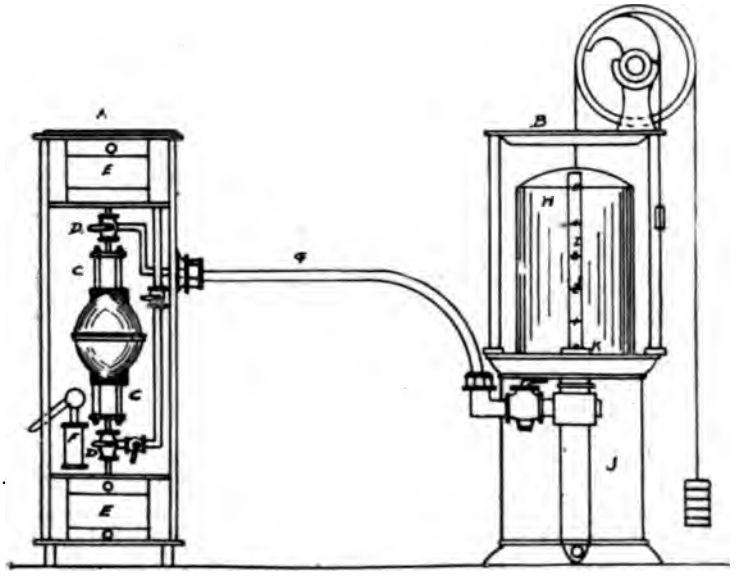
cycloidal counterpoise or by other means at all depths of immersion.

"Fill lower water tank of cubic foot bottle with distilled water until it overflows, at the temperature of air in the room, and water in prover, and they must be kept same throughout test.

"Pump water from lower tank into top tank until it overflows.

"Open stopcock at bottom of bottle and fill to the lower mark on glass gauge of bottle.

"Test connections between prover and bottle, and be sure they are tight before proceeding with calibration.



WRINKLE NO. 2.

"Mark a starting line on scale at either top or bottom of bell, set pointer on prover exactly on marked line.

"Open stopcock at bottom of bottle and fill with the water from top tank to gauge mark at top of bottle, causing the air in bottle to be forced into prover.

"Mark the scale at point where prover stops.

"Your bottle now being full of water, you can verify the test to be sure it is correct by opening stopcock between bottle and bottom tank, and draw the water from bottle back to lower

gauge on bottle again, and the operation will draw the air back from the prover into bottle again lowering the prover back to starting line.

"Pump the water from lower tank back to top tank again. Set prover at the line of second cubic foot and repeat the operation to end of scale, which will either be a 2, 5 or 10 foot prover.

"The marks on scale should be graduated into cubic feet and decimal subdivisions of a cubic foot.

"*A*, represents cubic foot bottle; *B*, meter prover; *C*, water gauges on cubic foot bottle; *D*, 3-way cock; *E*, water tanks on bottle; *F*, water pump; *G*, hose connections connecting bottle to prover; *H*, prover bell or measuring tank of prover; *I*, brass scale to be graduated into cubic feet and subdivisions of a cubic foot; *J*, water tank of prover; *K*, pointer at scale.

"These standard cubic feet bottles are of copper and are checked by the Government Bureau of Standards, Washington, D. C."—J. O. JONES, Laclede Gas Light Company, St. Louis.

DISCUSSION.

THE PRESIDENT—Gentlemen, I hope you will discuss these Wrinkles, making any inquiries that occur to you. It is a very large list for which reason Mr. Baehr requested that he be allowed to read by title only. I sincerely trust that that will not cut off any discussion. We want to hear from all who are interested.

MR. MCADAM—In Milwaukee we have the "Progress Club," a promoters' club, but we have not yet a "Wrinkle Club." I hope that when we do get one we won't use it for advertising Milwaukee.

MR. DOTY—I would like to ask Mr. McAdams if he will be generous enough to use the "Wrinkle Club" in Milwaukee to advertise the Western Gas Association.

THE PRESIDENT—Possibly Mr. Baehr found it cheaper to get his wrinkles in St. Louis than to use the postage necessary to stir up the members of the Western Gas Association.

THE SECRETARY—I will state, Mr. President, that Mr. Baehr used something like $40 worth of postage stamps, and if the members of the Western Gas Association did not respond it is only more to his credit that he himself secured the wrinkles from St. Louis.

MR. DOTY—Mr. President, in addition I may say that, through the generosity of our friends, the American Gas Light Journal, we had a standing advertisement for nearly a year, inviting contributions to the Wrinkle Department of the Western Gas Association. Thanks are due the Journal for their generosity in this regard.

MR. WARING—I think Mr. Baehr's letter rather frightened a number of the members of the Gas Association with the high class expected in the wrinkles; I know it did me. I was afraid that I could not give a wrinkle with him to set the pace for me.

THE PRESIDENT—Gentlemen, I hope we won't turn this into a discussion of apology and explanation, but that we will get down to the wrinkles and find something to talk about there. If there is no further discussion on these wrinkles, we will give Mr. Baehr an opportunity to explain why the Laclede stamp is on most of them.

MR. BAEHR—I question whether the Laclede stamp is taken in the sense that it is intended. My intention in asking contributions to the Wrinkle Department was to write only one circular letter, and that is all I did write. Of course, I sent that to as many people as I could reach. I don't think that it is wise for the Editor of a wrinkle department to attempt to keep after a man too hard, and I certainly did not do that. I, therefore, had to avail myself of all sorts of wrinkles where I could get them. In connection with Mr. Waring's remarks, that possibly that circular letter scared somebody out of a contributing, I will say I am very sorry at that interpretation, because the intention certainly was not to do it. I would have been very glad to have received any contributions, irrespective of the grade, and the only reason that I put in the question of grade at all was because, as I stated in my prologue, it is very hard to find a sufficient supply of wrinkles of those simple devices which have been put in heretofore. I think the wrinkle work could be improved very much, if everybody would make an effort to contribute along the lines I suggested. Of course, I am not inviting re-election. Thank you.

MR. DOTY—Before Mr. Baehr takes his seat I would like to have the pleasure of moving a vote of thanks to the Editor of the Wrinkle Department, and inasmuch as he had this experience of this year, and knows the work can be improved, I should like to nominate Mr. Baehr as Editor of the Wrinkle Department for another year.

THE PRESIDENT—That will be taken care of at the time we elect officers.

[The motion to thank Mr. Baehr was seconded.]

THE PRESIDENT—Gentlemen, it has been moved and seconded that the thanks of the Association be conferred upon Mr. Baehr for his able work as Editor of the Wrinkle Department. I believe in putting this motion, I am right in saying that on reading these wrinkles over you will find a very valuable lot of contributions and things that are original and unique. [Motion adopted.]

The President introduced Mr. Irvin Butterworth, of Grand Rapids, Mich., who read the following paper on

THE PREVENTION OF STOPPAGES IN SERVICES, METERS AND HOUSE PIPES DURING COLD WEATHER:

The majority of the cities in which the gas companies represented in this Association do business are located in the northern half of the United States, where the winters are so long and severe that much trouble is experienced from the stoppage of service pipes, meters and house pipes by deposits of frost and water condensed out of the gas. This is particularly true of the most northern cities; and with the exception of those in the extreme south, none of the companies are entirely exempt from this trouble. In this paper I wish in the first place to point out the seriousness of this imperfection in the gas business of to-day, and in the second place to mention and comment upon some of the remedial measures that have been proposed for its relief, or that have already been applied thereto with more or less success in European countries.

It is my firm conviction that the time has gone by when a gas manager can afford to content himself with following the methods now in vogue in this country for treating the routine difficulties incident to the distribution of gas in extremely cold weather. It no longer should suffice, nor indeed does it suffice, for a gas company to resignedly and complacently assure its consumer who suddenly finds his supply of gas cut off, say in the early hours of a long winter evening, by an insidious and unsuspected deposit of frost in his service pipe, that such an

interruption is now and then unavoidable in the gas business, that there is no way of preventing an occasional stoppage of this kind, and that a man will soon be out to free his service pipe of the obstruction and restore the flow of gas. I feel so strongly on this subject that I regard it as nothing short of an actual calamity for a gas company to have even one of its consumers thus suddenly deprived of his supply of gas on a single occasion. This may seem like an extreme view, but it must be remembered that people nowadays expect, and are warranted in expecting, a much greater degree of perfection, refinement and reliability than formerly in the mechanical devices and means through which the common necessities, comforts and conveniences of their everyday life are supplied. A few years ago the citizen rode to and from his place of business in winter in a slow and comfortless horse car. Now he is whirled along with a smoothness and swiftness in a comfortable car, heated by electricity or otherwise. The manufacture and distribution of gas have been carried on as a business for a hundred years, and the thinking layman, in this age of mechanical progress and refinement in other long established industries, expects, and has a right to expect, that by this time surely, gas men have devised means and methods for insuring the continuity of the gas supply at his premises in winter as well as in summer. And yet during 3 months of the winter of 1003-4 in the little city of Grand Rapids, where the distribution of gas is accomplished along rather better lines than the prevailing good practice of the day, most of the service pipes being boxed in tar concrete, there were 3.000 individual interruptions of the gas supply due to frost and water in the pipes and meters. Detroit has relatively as many, and if the companies in other cities should make an honest confession, the disclosures by each of them would be equally discreditable to the gas business in these modern times. I am aware that the winter mentioned was exceptional in the severity and persistency of its cold weather; but the inconvenience, discomfort and distress, not to say the actual damage, the gas companies cause their consumers, even in average winters, by their failure to provide some pure preventive of these interruptions, are a sad commentary on either their engineering skill or their business judgment. Furthermore, gas is now used in the average household for so many different and important

purposes that an unexpected stoppage of the supply by day or by night, but particularly by night, has become a much more serious matter to the consumer, and therefore to the gas company than formerly. Time was when the gas was used for light only and in many cases in only two or three rooms in the house. Lamps or other means were always conveniently at hand for obtaining light from oil or otherwise, at short notice, in the event of the failure of the gas. The sudden stoppage of the supply of gas under those circumstances was not a very serious matter and consumers of those days were patient and forbearing; but nowadays, especially if the company's new business department has been doing its full duty, the average consumer depends altogether upon gas, not only for lighting his house throughout, but also for cooking, for heating water, for warming some of his rooms and for other purposes, with no other means at hand as a quick substitute for the gas for either purpose. The interruption of the gas supply in such cases cannot be otherwise than a most serious matter to the consumer and in the not infrequent event that the house at the time contains visitors, or that a party or other social function is in progress, extreme annoyance and humiliation add to the consumer's irritation and chagrin; while in case of sickness the consequences may be even more calamitous.

It is considerations such as these that impel me to the conviction expressed above—that gas companies, in northern cities at least, should not content themselves with following the present antiquated and inadequate methods of dealing with these troubles. It is not right, nor is it good business, for the company to wait until the unfortunate consumer telephones that he is out of gas and then send a man, perhaps half an hour later, with a can of wood alcohol, a pipe wrench and a lantern, to cut the frost out of the service pipe. This is locking the stable door after the horse is stolen with a vengeance, especially from the consumer's standpoint. I admit that most companies have sought to reduce the number of these interruptions of the gas supply by laying all new services at a greater depth and by keeping a list of all services that freeze up during the winter and then so enlarging or protecting them during the following summer that their stoppage from this cause is not liable to recur; but this is only an imperfect and partial remedy. The following winter may be

much more severe, resulting in a recurrence of the trouble in those same services and in its fresh appearance in many others; and even with no apparent difference in temperature conditions, services and house pipes that do not freeze or stop up during one winter may, on account of the vagaries of frost and weather, and even from unknown causes, do so during the next. It is practically impossible to entirely anticipate and prevent in this way all freeze-offs and stoppages, although good work may be and has been done in this direction, bringing about as great a degree of immunity from these troubles as is possible under the present imperfect methods of treating and preventing them but they still leave much to be desired. For, on account of what I regard as the increasing seriousness of our allowing even a single consumer to be without gas on a single occasion, I believe it is our duty, and greatly to our interest, to adopt some new and radical method calculated to completely prevent these difficulties.

Let us now see what choice of such measure we may have, and discuss briefly their relative merits. I will consider the following seven methods, some of which have been tried, while others as yet, have been only proposed. Still other methods have been proposed, but a consideration of the following will suffice for my present purpose:

1. Drying the gas by washing with sulphuric acid.
2. Drying the gas by exposure to calcium chloride.
3. Drying the gas by exposure to quicklime.
4. Drying the gas by exposure to calcium carbide.
5. Drying the gas by compression.
6. Drying the gas by air condensation in overground pipes or air condensers.
7. Reduction of freezing point of vapors contained in the gas by the admixture of alcohol vapor.

It will be observed that all of these methods contemplate some treatment or manipulation of all of the gas as it passes from the holder outlet into the street mains, and that the first six contemplate the removal from the gas of the water vapor contained therein, at least such portion of it as will render the remaining moisture insufficient to cause any trouble; for it is said to have been found, according to Dr. Harrop, that .6 per cent. of water vapor can be safely left in the gas, this being half of a total of 1.2 per cent. which is about the quantity that saturated gas contains

as it leaves the holder under average pressure conditions and at a temperature of, say, 50° F., or about 12 cubic feet of water vapor for each 1,000 feet of gas. I would feel that it would be safer, however especially in extremely cold weather, to remove practically all of the water vapor from the gas, if this can be economically accomplished. Obviously, if the water vapor be removed there will be no stoppages from frost or water, and an incidental benefit which must not be lost sight of would be the prolonging of the life of our meter diaphragms which, as is well known, are greatly injured by condensation in the meters, especially when such condensation is not of an oily nature. The chief object to be attained, of course, is the prevention of stoppages caused by cold weather, and such being the case, any method employed for this purpose need not be operated except during the two or three coldest winter months; but there is not much condensation in meters during the other months of the year in any event. Furthermore, it is generally recognized among gas men that the moisture in the gas favors the deposition of naphthalene, and so by drying the gas we "kill two birds with one stone," getting rid of stoppages from both naphthalene and frost. To my mind, therefore, some method of desiccating the gas would be preferable, if a feasible and economical one could be found, to method No. 7 (the introduction of alcohol vapor), which leaves all the moisture in the gas, allowing it to condense in the pipes and meters and only aiming to so lower its freezing point that it will not congeal. I confess, however, that method No. 7 is the only one that is at present in successful use, notwithstanding the fact that the desirability of distributing desiccated gas has long been recognized, the American Gas Light Association having discussed this question as long ago as 1872. Let us consider the foregoing methods in the order given:

Drying by Washing with Sulphuric Acid.—This method contemplates passing the gas through some sort of material, like pumice stone, wetted with sulphuric acid, which would absorb the water vapor out of the gas and which could then be strengthened for re-use by driving the moisture out of the acid by heat. This method is apt to be the first one to occur to us on superficial consideration, but it is now generally recognized to be impracticable because the acid would rob the gas of too much of its illuminants. Furthermore, a trial of this method in Germany in

the winter of 1895-6 showed that it did not prevent stoppages of pipes from the congealing of the benzol. (See "Progressive Age" of April 15, 1896, page 187.) It is likely that no method of desiccation would prevent this. But benzol enrichment is not generally practiced, particularly in this country.

Drying by Exposure to Calcium Chloride.—This method contemplates passing the gas through, or bringing in contact with, calcium chloride, which by its affinity for water would absorb the moisture out of the gas. It has been tried with success on the premises of consumers, for instance, in Cracow, Austria (see *Journal of Gas Lighting*, March 13, 1900, page 681), but, so far as I know, has not been attempted anywhere as a means for removing the moisture from all the gas as it enters the street mains from the holder. This method would necessitate not only rather expensive apparatus, but the cost and difficulty of revivifying the material for re-use would probably make it uneconomical.

Drying by Exposure to Quicklime.—This method would be similar to the preceding and probably much more economical, but I cannot find that it has ever been tried on a large scale. From data furnished me by Dr. Harrop, I calculate that with gas at 50° F. 1 pound of freshly burned lime per 1,000 cubic feet would suffice if the gas was properly exposed to it, to reduce its moisture content to .6 per cent. A portion of this lime, equivalent to about .4 of a found per 1,000 cubic feet of gas treated, could be afterwards utilized in the ammonia concentrator, leaving the net quantity of lime chargeable to the desiccation of the gas about .6 of a pound per 1,000 cubic feet, costing say about ⅛ cent. Or if enough lime was used to practically completely desiccate the gas which would be preferable, it would cost twice this much, or say, ½ cent per 1,000 cubic feet. While the first cost of the lime itself would, therefore, not be excessive, this method might nevertheless not prove as economical as some of the others under consideration on account of the first cost of the necessary apparatus and the cost of handling the material.

Drying by Exposure to Calcium Carbide.—This is a method proposed (originally, so far as I know) by Mr. F. Egner in 1894, who pointed out that calcium carbide "would make a most excellent dehydrating agent, the carbide taking up the water vapor and nothing else, and the resulting very rich acetylene being

conducted along with the gas and evidently doing it no hurt." He had in mind the possibility of using it for the purpose which we have under consideration, but, so far as I can discover, the experiment has never been tried, notwithstanding the idea is very attractive. The apparatus for its use would be comparatively inexpensive, but at present open prices, the carbide would cost about $70 per ton, or 3½ cents per pound, and 1 pound of the commercial article (say 90 per cent. pure) would absorb only about 10.5 cubic feet of water vapor, which would be the quantity contained in 875 cubic feet of gas at 50° F. In other words, the carbide necessary to reduce the water vapor to .6 per cent. would cost 2 cents per 1,000 cubic feet of gas treated, while enough to entirely desiccate it would cost 4 cents per 1,000 feet. This method would therefore be quite expensive, notwithstanding the resulting acetylene would enrich the gas to some extent. The enrichment would not be considerable, if coal gas was being made, particularly if the absorption should generate high temperatures which would be injurious to the acetylene itself and also to the gas being treated. It is not likely, however, that this would be the case.

Drying by Compression.—This method contemplates compressing the gas by an ordinary compressor or otherwise, to a point that would "squeeze out," as it were, enough of the water vapor to render the gas safe from freezing, and then releasing the gas into the mains at ordinary low pressure, for distribution. As stated above, it is said that a residue of .6 per cent. of water vapor may be left in the gas with impunity. While this seems doubtful, it is a fact that the removal of even a small portion of the water vapor seems to have an astonishingly large effect in the reduction of the number of freeze-offs. An examination of the complaint books at Detroit during the winter 1903-4 shows that there was a decided falling off of complaints in the vicinity of their high pressure pumping lines, notwithstanding the gas was subjected to only 2 pounds pressure; and yet compressing gas under 15 pounds pressure removes only half of its water vapor, which would, at 50° F., leave about .6 per cent. in the gas. But to do even this would cost about 1½ cents per 1,000 cubic feet, as artificial cooling would also be necessary. In fact, while compressing the gas would be a perfect preventive of freeze-offs and condensed moisture, as is shown by the experience of gas

companies that distribute high pressure gas only, yet compressing it for the sole purpose of desiccation, would be much more expensive than some of the other methods. Our consideration of this method brings strikingly to our attention one of the conspicuous advantages of high pressure distribution, namely, the absolute prevention of stoppages from freeze-offs and condensed moisture.

Drying by Air Condensation in Over-Ground Pipes or Air Condensers.—This method of desiccating artificial gas has not, to my knowledge, yet been tried on a large scale, although it is successfully employed by some natural gas companies in removing the entrained water from natural gas. (See *American Gas Light Journal*, of November 21, 1904, page 802.) Although the problem of its application to artificial gas is much complicated by the danger of condensing out the illuminants as well as the water vapor, I confess that this method appeals to me as offering great and promising possibilities. No machinery or chemical agencies are needed, and very inexpensive apparatus can be employed, while the labor cost would be extremely small. All that is required is a system of pipes laid above but not directly upon the ground, or almost any other sort of large air condenser, connected by means of valves with the holder outlet in such a manner that in cold weather the gas could be passed through this condenser, thus subjecting it to air condensation, the amount of exposure being varied by means of valves according to the fluctuations in the temperature of the air, and at no time cooling the gas to a lower temperature than it would reach in any event in passing through the mains and consumers' services. In this way there would be no greater loss of candle power than would occur if the device were not in use. In fact, we could err on the safe side by not chilling the gas below the temperature that it would reach in the warmest service in the city, and still free it of enough of its moisture to secure us, in my opinion, immunity from the frost and condensation troubles that now make the life of a gas man miserable in cold weather. With one intelligent man in charge of this air condenser, it could be manipulated with absolute nicety, producing exact and ideal results if such were necessary. But, in my opinion, the apparatus would do its work sufficiently well for all practical purposes without painfully close watching or micrometer regulation. It would only be necessary not to chill

the gas below the temperature that it would reach in the warmest services and as our troubles from frost and condensation would probably disappear before this point should be reached, the range of temperature fluctuation produced by the apparatus could safely cover quite wide limits. It would probably be necessary to provide duplicate condensers, in order that they might be alternately by-passed to permit the removal, by steam, air or other means, of the frost that would deposit in them from the moisture in the gas.

A conviction of the probable efficacy of this method is forced upon us by well-known experiences of many gas companies. The St. Paul Gas Light Company, during the winter of 1903-4, had much less trouble than usual from freeze-offs, when the opposite experience would naturally have been expected, simply because the weather was so very cold that the quantity of moisture in the gas as it left the holder was in the first place less than usual, and in the second place was nearly all condensed out before the gas reached the consumers' services. In Detroit, during the same winter, there was a system of partially overhead small distribution pipes running to and through various building at the gas works. Some parts of these pipes kept continually freezing up until a large iron vessel, made out of a 16-inch gas pipe, which acted as an air condenser, was installed in the main feeder of this system as it emerged from the ground, and immediately the freezing ceased, the moisture, or enough of it, being thus removed. The U. G. I. Companies have for years been in the habit of enlarging their lamp post risers where they leave the ground, the enlarged portion serving as an air condenser and thus practically preventing all freeze-offs. In Grand Rapids about one-fourth of the gas consumers live on the west side of the Grand river, the remaining three-fourths being on the east side, where the works are located. The west side consumers are supplied through pipes supported where they cross the river on bridges some 600 feet long. An examination of our complaint books shows that on the east side of the river there were, during the three coldest months of the winter of 1903-4, six times as many stoppages from frost and condensation per 100 meters as there were on the west side, the difference being wholly due to the exposure of the gas supplied to the west side, to the cooling effect of the air as the gas passed through the pipes on the

bridges, as other conditions were the same throughout the city. The proposed air condenser at the holder outlet would merely perform this desiccating function for the gas supply of the entire city, only it would do it more thoroughly and with more safety to the candle power, being at all times under full and easy control. It would be used, as I have said, only in extreme weather, being by-passed or artificially cooled during the warm hours of mild winter days and put into use again as the evening coolness and hours of maximum consumption came on. To my mind, this is the most promising desiccating method of preventing troubles from frost and condensation.

The Reduction of Freezing Point of Contained Vapors by Admixture of Alcohol Vapor.—This is the only method that does not involve the desiccation of the gas; and furthermore and unfortunately, it is the only method that is now in successful use. In fact, as far as I know, it is the only method that is now being tried, either successfully or unsuccessfully. It is fully described and illustrated in the *American Gas Light Journal*, June 15, 1896, page 966. It is the invention of Dr. Bueb, Chemist of the German and Continental Gas Company, of Dessau, Germany, and has, I understand, been patented in this country. It is a scheme and apparatus for introducing into the gas as it enters the street mains from the holders the vapor of wood alcohol, which so lowers the freezing point of the water and other congealable vapors contained in the gas, including benzol, that they do not deposit in the pipes as frost or otherwise. The apparatus is very simple and inexpensive, and consists of an elevated tank containing the alcohol, a regulator for controling the rate of flow of the alcohol, into the vaporizer, a vaporizer for volatilizing the alcohol either by steam or dry heat, and a pipe leading thence in the holder outlet. For temperatures down to 14° F. about ⅓ of a pint of alcohol is necessary per 1,000 feet of gas, and for temperatures between 14° F. and, say, 6° F. below zero, about half a pint is necessary.

As early as 1896, twenty-nine gas works in Continental Europe, principally in Germany, were using this method, introducing the vapor during only the hours of evening consumption; and from an advertisement in the German Gas Journal of December 3, 1904, I noticed that the method is now being used in no less than 193 different cities. I also have recent letters from Dr. Bueb's

associate, William von Oechelhaeuser, of the gas works at Dessau, Germany, who assures me that the method is very successful and is being extensively adopted and used in Europe. This somewhat surprises me, on account of the high cost of the alcohol used, but Mr. von Oechelhaeuser explains that because of the absence of duty charges the cost of the alcohol in Germany is not prohibitory, as it would almost be in this country. For instance, at 60 cents per gallon, the present price of wood alcohol in Grand Rapids, ⅓ of a pint, or enough per 1,000 cubic feet of gas treated to prevent stoppages at 14° F., or over, would cost 2½ cents while ½ of a pint, or enough per 1,000 feet to prevent stoppages at temperature between 14° F. and -6° F., would cost 3¾ cents. With our present output at Grand Rapids, even if we should use this method during only the three hours of maximum consumption, the cost in below zero weather would be about $30 per day, and, as a matter of fact, on account of the extensive use of gas during the day time, it might be necessary, after all, to vaporize the alcohol during, say, 12 hours out of 24, which would make the cost about $65 per day. Of course, we would save the cost of the alcohol and labor now employed in freeing service pipes in the usual way, and would prevent the annoyance of our customers, which is the chief object to be attained; but this saving and result should, of course, be credited to each of the methods which we have been considering. We have experimented with this method in Grand Rapids during the past winter, vaporizing in the holder outlet, during a portion of our coldest weather, ½ pint of wood alcohol per 1,000 feet of gas passing through it, with the result that we effected a very marked decrease in the number of freeze-offs; and we should probably have eliminated them altogether had we not been obliged to put our make of gas, during the hours of heaviest consumption, directly into the street mains, by-passing the holder. This gas, not having had the benefit of holder condensation, contained an excessive and abnormal percentage of water vapor, for the complete control of which the quantity of alcohol used was apparently insufficient.

Because of the fact that the gas enters the holder at a uniform rate throughout the 24 hours, but leaves it at widely varying rates, it seems that the proper location for the desiccating apparatus, whichever kind should be employed, would theoretically be on the holder inlet, rather than on the outlet, as much smaller,

and therefore less expensive, apparatus would thus be required. In this event, however, it would be necessary to keep the water in the holder tank covered with some kind of oil that would prevent the absorption of water vapor by the dried gas. Although this could probably be successfully accomplished, I have treated this subject on the assumption that the apparatus would be placed on the holder outlet.

If I have made no error in the foregoing calculations, it seems probable that the quicklime method would be much cheaper than the alcohol method that has evidently obtained so strong a foothold in Europe. But, in my opinion, the air condensation method would be the cheapest of all, both in first cost and in operation. While my investigations and experiments have not yet gone sufficiently far to warrant my stating this as a definite and positive conclusion, it is at least evident, I think, from the foregoing discussion of some of the available and feasible methods of prevention, that gas companies should no longer jeopardize their own and their consumers' interests by following the present ancient and ineffective methods on the plea that there is nothing better.

DISCUSSION.

THE PRESIDENT—Gentlemen, this very thoughtful and painstaking paper is now before you for discussion.

MR. MCADAM—Respecting Mr. Butterworth's remark that "The difference being wholly due to the exposure of the gas supplied to the west side to the cooling effect of the air as the gas passed through the pipes on the bridges, as other conditions were the same throughout the city." I would like to ask him if any provision was made for taking care of stoppages in these bridge pipes by putting alcohol in them. The reason I want to know is that I think an excessive use of alcohol on these bridge pipes would have a tendency to saturate the gas to such an extent that it would prevent stoppages.

MR. MILLER—One result of drying the gas to a marked degree Mr. Butterworth did not consider at all in his paper. We had an experience in certain sections of our plant where it is supplied with compressed gas, or gas that has been compressed, that seemed novel. When we started the Algiers supply we

decided to there use wet meters entirely, as we had a large stock of them, but we found out that we had to fill those meters about three times a week. The dry gas would take the water out of the meter so fast that it would shut off. Then we changed all the wet meters and put in dry ones, and in the course of 2 or 3 months we found those meters were all slow. An examination showed that the dry gas had taken absolutely all of the oil out of the leather, and the latter was passing gas just like a sieve. We found like conditions in other districts in the city where they were getting gas coming through the high pressure system. While it may be a desirable thing not to have moisture or condensation in your meters, if you get the gas too dry you will have trouble with your leathers. To overcome this effect we put it up to the meter manufacturer to supply us leathers properly saturated, so that the gas would not take the oil up. But the situation was too serious with us, so we tried the scheme of oiling the diaphragms from the inside—taking the top off the meter and opening à valve, pouring the oil in the diaphragm, with some lampblack or graphite, oiling it from the inside and then draining it out. We got tolerably good results from that. Still that oil is taken out of the leather, and very frequently we find it deposited in the meter in the shape of condensation.

THE PRESIDENT—I would like to ask Mr. Miller if he finds that oil deposit in the meter itself. Or is it carried on with the gas?

MR. MILLER—We found one case (where I don't recall) where nearly ½ pint of oil was gotten out of the meter, which I had identified in the laboratory as being the same oil as that we had used in the leathers.

THE PRESIDENT—But you did not find that to be universally the case?

MR. MILLER—Oh, no; usually the leathers are left dry.

THE PRESIDENT—And the oil had disappeared entirely?

MR. MILLER—Entirely.

MR. ELBERT—I made a few notes on Mr. Butterworth's paper and I believe it will be the means of shaking up as it were those in the department whose duties require them to attend to this particular branch of the distribution of gas. In following out any of the various schemes as suggested for arresting the aqueous vapor, it looks to me as if it is shifting one of the troubles properly

belonging to the distribution department to the manufacturing end of the business. This, however, might be a move in the right direction, if the suggested remedies will perfect an ideal preventative for the depositing of frost or condensation in the service pipe. I am of the opinion, however, it would not be an entire success. I prefer more particularly to the drying by air in overground condensers. There is no doubt the aqueous vapor can be removed by exposing enough condensing surface to the gas in its passage from the holder to the street mains. This, however, would have to be of a sufficiently large surface to take care of the gas on a maximum load. This accomplished, and the vapor, reduced to water, freezes and must be removed again by heat, which at once spoils the effect of the condensing apparatus. At St. Paul we supply a large proportion of our consumers in the east and west districts through mains crossing on bridges. There are practically no frost cases in this territory, but the bridge pipe requires constant attention during the winter, and we are obliged to flush them with hot, salt water, pumping the same from the drips. This system or something similar no doubt would have to be applied to the air condenser at the works, and as stated above, spoils the effect desired. Again, I cannot see the use of doctoring all the gas with the danger of reducing the candle power when only a small per cent. of the consumers are ever troubled with frost. Our Company, from December 1st, last, to May 1st, this year, which covers all our frost cases for a year, had 2,714 complaints. A large number of these were duplicated, many times from one customer. Assuming, however, these complaints represented individual consumers, and comparing them with the total number, we would average about one complaint to 5½ consumers for the year, or each consumer requiring attention once in 5½ years, and owing to our latitude I do not believe any gas company would have any more than this. This does not look to me as being an "actual calamity" in failing to supply, partly or wholly, a consumer once in 5 years. The electric light, telephone or water companies cannot boast of better service, and as to the "citizen riding to and from his place of business swiftly and in a well heated car" lighted by gas, while it is an improvement over the horse car, the only constant comfort is the gas light; and many times during the winter months the public are seriously inconvenienced, and I believe

the gas companies of to-day are supplying their consumers with less interruption than either of the above mentioned companies. Getting back to the service, if the average service does not freeze, why should any of them? The laying of a service in tar or concrete as at Grand Rapids, is, no doubt, a good preservative to the pipe, but by no means a non-conductor of frost; on the contrary, it is one of the best, as frost penetrates through a compact mass and remains longer than in a loose or disintegrated covering. The laying of a service at a great depth is but little better than a moderate covering, and will not remedy the frost trouble entirely, whether a winter is severe or not, and as a remedy I would say a service should never be less than 1¼-inch or larger and when necessity occasions, should be laid in the center of a wooden box or tube large enough to form a dead air space, with the ends cemented or closed—this covering to extend through the wall. In no case allow a service to be leveled with stone or brick or extend through a wall without a box or tile around it. Now, as to the house riser and meter in exposed places, a dehydrator, a description of which appeared in the *American Gas Light Journal*, March 7, 1904, could be used to good advantage. This is the Wrinkle of one of our members, Mr. F. C. Shepard, of Minneapolis, and I understand his Company has some 300 in use with perfect success. The device costs but a trifle, and the maintenance is very low, requiring only a little excelsior and broken up lime. Once a year these are changed and others substituted, the old ones being refilled. I have with me a full sized model with one side of glass for your inspection. This size will take care of 5 arc lamps, and for inside arcs in large numbers, such as are required in livery stables, warehouses, etc. The device is cylindrical in form, 12 inches in diameter, 24 inches long, set vertically and supplied with a by-pass that it may be easily removed and another inserted. Now, a word for the lamp post. Some years ago, having much trouble with keeping lamp post risers free from frost, I conceived the idea of setting every post to form a dead space. This was accomplished by fitting boards tightly over the two slots in the base of the post, keeping the post free from dirt and the ell at the bottom entirely free of any covering, the top of the post being plugged with a wooden block with an inch hole for the riser to pass through. I found this remedy almost perfect, and the post required very little

attention. In short, I believe that gas companies in general are not paying enough attention to the details of the service laying.

MR. WARING—This paper does not take into consideration the water that leaks into the mains that run through low ground where the mains are laid in water. It seems to me where a great many run through the bottom of the river, there would be leaky joints admitting water which would destroy the effect of desiccation by resaturating the gas— it speaks also of oil on surface of water in holder tank. It strikes me that a variation of temperature would make the candle power fluctuate by the evaporation of the oil.

MR. MITCHELL—I believe the point has been brought out here, Mr. President, that we have troubles in our gas condensing, causing stoppages of the flow of gas to our consumers, and then we have an example here in New Orleans wherein the gas is dried too much. I think there is a point between the New Orleans experience and our other experiences where we can dry the gas so that it will not bother us one way or the other, and I think we can work and find that point. I believe Mr. Butterworth's idea is correct, and I think we can get to a point where we do not condense it more than necessary.

MR. WORTENDYKE—One great thing against systems of desiccating gas is that it necessitates the introduction between the outlet of the holder and your city of some apparatus that may stop the gas from the entire city, and that would be much more serious than having a shut off for quite a number of isolated consumers. Although alcohol may cost more and not do the work quite so well, yet there is absolutely no way in which it can produce a shut off of the entire town.

THE PRESIDENT—Is Mr. John R. Lynn in the room? Mr. J. M. Berkley? Mr. Jansen Haines?

MR. HAINES—Mr. Chairman, I have not prepared any discussion on this subject.

THE PRESIDENT—One point that Mr. Miller brought up which is a little obscure to me is the removal of the meter oil by means of the dry gas. I can hardly understand how that is done, for the oil should disappear along with the gas. From the experiments we have made meter oil is not soluble in gas, but is soluble in oil that is condensed from gas. It seems to me that if his meter diaphragms bleached he should have found a combination of the

meter and drip oil in these meters in which diaphragms were bleached. It was for that reason I asked Mr. Miller if he found the oil universally in the meters.

MR. MILLER—The oil was.

THE PRESIDENT—That is what I would imagine.

MR. MILLER—I know this, that you use the correct term when you say bleached, because the leathers were almost white, and your expression of not understanding it was exactly the attitude that I was in when I went "against it."

THE PRESIDENT—Is Mr. Gimper in the room? Gentlemen, if no one else cares to take part in this discussion we will hear from Mr. Butterworth.

MR. BUTTERWORTH—In reply to Mr. McAdam, we did use alcohol in the bridge lines at Grand Rapids, of course, in large quantities, but I do not believe that was the cause of the reduction in the number of freeze-offs in the territory supplied through them, because it was evident, from the frost found in these pipes, that here was where the moisture had already been deposited out of the gas. Mr. Miller's objection to the drying out of the diaphragms I think was answered by Mr. Mitchell. We don't need, necessarily, to dry the gas completely; we could dry it as much as is necessary to prevent these interruptions, and leave some moisture in the gas, so that the meter diaphragms will not necessarily be dried out. In this connection I would like to inquire of some of the gas meter manufacturers what their experience is with meters used by companies supplying high pressure gas, which, of course, is dry gas. I would like to have some meter man tell us what is the experience in that matter. Now, Mr. Elbert pleads that conditions in St. Paul are not bad, as they only had 2,700 different consumers affected by interruptions in their gas supply during the winter. I think that is very bad. He admits himself that some of these 2,700 had duplicate interruptions. Probably some of them had triplicate interruptions. If he had 2,700 different consumers out of gas in one winter, that probably means 4,000 or 5,000 individual interruptions in a town not having more than probably 15,000 or 16,000 consumers. I think that is very bad. No matter how much better we may be doing than possibly some other public service corporations, it is up to us to do still better if we can, undoubtedly. I think his device for preventing individual freeze-offs in those particular services

which he knows to be bad and liable to make trouble, is all right; but it is only a makeshift after all. It is only a partial remedy. We don't know where these troubles are going to occur. They appear where we least expect them, and where they don't appear in one severe winter, they may appear in the following, although it is not so severe. That has been the experience of all of us. I would like to hear from the gas meter men as to what troubles they have as to the drying out of the meter diaphragms of a high pressure gas company.

THE PRESIDENT—Is Mr. Gribbel present? Mr. McIlhenny, will you enlighten us on this subject?

MR. MCILHENNY—As far as the manufacturers of meters are concerned, I do not think the question brought up by Mr. Butterworth has been brought to their attention. There may be two reasons to account for that. One is that the distribution of gas under high pressures is of rather recent date; that is, it has not been practiced for more than a few years past, and the results if any have not made themselves manifest. I know of no complaint from meters used in measuring gas distributed under high pressure as to any deposit or otherwise in the meters. As to natural gas, which is, of course, subjected to high pressure, I would say it is as a rule perfectly dry, and I would say that conditions are ideal for meters measuring natural gas. I have seen meters opened that had been measuring natural gas for 10, possibly 15 years, and the meters internally were in as beautiful condition as they were the day they were originally made, a filmy oil which carries along with the natural gas being spread all over the interior of these meters. An evidence of the ideal condition under which natural gas meters work is seen also in the fact that there are practically no repairs required by such meters. I know of thousands of such meters that have been in use in single towns for 10 to 15 years, and there practically is no call for repair parts; that is for natural gas which is free from sulphuretted hydrogen and which is not too close to the wells. When natural gas was first distributed, occasionally the gas was taken off in close proximity to the wells, and occasionally fine particles of grit accompanied the flow; but nowadays, on the long distance transmission lines, that grit is practically removed before it reaches the towns.

THE PRESIDENT—Any further remarks on this subject?

MR. BUTTERWORTH—The gentleman from Janesville spoke about the danger of an apparatus placed on the holder outlet interrupting the supply of gas to the city. I don't think there would be any danger. I don't see why a condenser could not be placed on the holder outlet that would be perfectly safe. As I suggested, they should be in duplicate, so that Mr. Elbert's objection also would be overcome. We could clean one while using the other.

MR. MCILHENNY—Mr. Chairman, I move a vote of thanks to Mr. Butterworth for his valuable paper. I would say also that this is a new line of thought, and we are particularly indebted to Mr. Butterworth for having brought it up. I believe that sufficient attention has not been paid in the past to remove difficulties found with gas outside the works. I know, in connection with the subject of meters, that if the excess of condensation be removed before it reaches the meters, the expense of meter repairs, and difficulties with meters, would be very largely removed by just such suggestions as Mr. Butterworth advocates. The great source of trouble in meters is condensation, and if we can remove that the meter will be thereby benefited that much, and the company put to that much less expense. [Seconded.]

THE PRESIDENT—A vote of thanks has been moved and seconded on behalf of Mr. Butterworth. I wish to say in this connection that this is a subject that could be well followed out and cumulative papers could be written on it, until finally we would arrive at some definite device or system of preventing these stoppages. I think it would be well if Mr. Butterworth would consent to carry on his investigations and report again next year to the Association. Gentlemen, you have heard the question. [Adopted.]

The President then introduced Mr. J. B. Morehead, of Chicago, who read the following paper on

CALCIUM CARBIDE AND ACETYLENE.

By a carbide is understood a combination of a metal, or of an alkaline earth and carbon. The carbides are not to be confounded with the much more numerous family of carbonates, which contain oxygen in addition to the above and possesses entirely different physical and chemical characteristics. Carbides

do not exist in nature, but it is probable that those of almost all of the metals can be formed artificially by means of extreme heats, etc. Carbides of most of the metals have been produced and studied, but only two are of any commercial value, namely: Carbide of silicon, which is sold under the trade name of carborundum, and is used as an abrasive, and carbide of calcium, which is sold as such and used as a source for the commercial production of acetylene.

Early in 1891 a plant was established on a water power in North Carolina, for the production of aluminum, the name of the Company being the Wilson Aluminum Company. As the process of the manufacture of metallic aluminum did not work out the Company engaged in the production of alloys of aluminum and copper. These were made by fusing a mass of copper in an electric arc furnace and then adding a mixture of aluminum oxide and carbon. When the mixture was subjected to the heat of an electric arc the carbon would take the oxygen of the alumina and copper would take the aluminum. As it was not possible to get the proportions just right in the furnace, it was the custom to make the alloys richer in aluminum than was required; then by drawing off a sample and making a hurried chemical determination of the proportions of copper and of aluminum, sufficient copper could be added to the bath to dilute the mixture down to the required proportions before it had cooled below the melting of copper. To avoid the necessity of reheating the mixture in the furnace the utmost dispatch was essential in the drawing and cooling of the sample and in its analysis, and so a small sample was drawn from the crucible, plunged into water and the analysis rushed through.

While the Company was engaged in the manufacture of aluminum alloys it was still experimenting with a view of perfecting the process for the manufacture of metallic aluminum. A series of experiments was instituted along the line of first producing metallic calcium by reducing lime with carbon. It was proposed to then use the metallic calcium as a reducing agent for the alumina to produce aluminum. On the first run for the purpose of producing metallic calcium to be used as a reducing agent, lime and coal tar were mixed in a caldron and put in the electric furnace. After a run which lasted for several hours on this mixture a sample was taken out of the furnace, and in accord-

ance with the usual custom was placed in water in order to cool it for an analysis. Upon introducing a piece of the product of about 1 pound weight into the water, large volumes of gas were given off, and at first it was thought that the substance was metallic calcium, that the gas given off was hydrogen, and that the first step in the process of making metallic aluminum had been accomplished. Upon lighting the gas, however, it was found to burn with a heavy yellow flame and to give off quantities of soot which proved to be some rich hydrocarbon gas and not hydrogen, as was supposed. Subsequent analyses of the substance made at the Company's laboratory proved it to be calcium carbide. For want of gas analyzing apparatus at the local laboratory some of the carbide was sent to the University of North Carolina, and the gas was there analyzed and pronounced acetylene. Up to that time it was called "carbide gas." This first experiment was made May 4th, 1892. While calcium carbide had been spoken of as a chemical possibility and a laboratory curiosity for some time, and had possibly been produced by the use of metallic potassium, chlorate of potassium, etc., in very small quantities by various laboratory methods of interest only to the theoretical chemist, and while acetylene is of possibly older origin, they were in the same class which now embraces casium, helium, argon and other rare chemical possibilities known only to the theoretical chemist, whose business it is to know them, but which the average man possibly never heard of, certainly never saw, and to whom they do not exist at all.

When a process is discovered by which it is possible to produce a substance by tons, which before has been produced only by grammes, when a substance is made so that practically unlimited quantities are placed with the reach of all at a low price, where before only a limited quantity existed and that not on the market; when a substance becomes so common that its properties and appearance become familiar to all intelligent people, and its name a household word, where before its properties were matters of conjecture among a few experts and its name never heard outside of a laboratory, it may fairly be considered a new substance and its birth may be said to date from the date of the discovery which made these changes possible. Hence, it can be fairly stated that calcium carbide was discovered May 4th, 1892.

Calcium carbide is a crystalline body, hard, brittle and varying in color from almost black to brick red. Its specific gravity is 2.26. A cubic foot of crushed carbide weighs 138 pounds, and in weight, color and most of its physical characteristics is about like granite. If broken hot the fracture shows a handsome, bluish purple iridescence and the crystals are apt to be quite large.

Calcium carbide is insoluble in most acids and in all alkalies, it is non-inflammable, infusible, non-explosive, unaffected by jars, concussions or time, and, except for the property of giving off acetylene when brought in contact with water, it is an absolutely inert and stable body. The transportation companies afford it the same classification for shipment that is given nails or spikes in kegs. Chemically it is described by the formula CaC_2, and has 62½ per cent. of calcium and 37½ per cent. of carbon. It is made by the reduction and combination in an electric arc furnace of a mixture of finely pulverized and intimately mixed calcium oxide or quicklime and carbon in the shape of coke. There is no adequate way of measuring the temperature necessary for the production of calcium carbide, and any estimate is merely approximate, but it is calculated to be from 5,000 to 8,000°F.

When we consider that the arc light people and the other electrical users employ carbon for their electrodes, because it is the only substitute which will stand the extreme temperatures, and that the carbide makers themselves and also the carborundum people use carbon electrodes for the same reason, and further that the crucibles of lime are used in gold and silver assaying, and for the pencils of the Drummond oxygen-hydrogen light on account of its extremely high fusing point, and then remember that carbide making is purely thermal reaction and that these two bodies which are about the most infusible substances known to science are mixed pure—without any flux whatever—and driven into unwilling combination by virtue of sheer force and violence of the temperatures obtainable only in the crater of an enormous electric arc, it will be appreciated that the temperatures required and attained in this process are something simply terrific. The furnaces employed from 250-350 electric power each and produce about one ton a day. The output is crushed to different sizes and packed at the rate of about 50 tons a day in the two factories, and it is sold for $70 per ton at the works.

There are a few chemical uses for calcium carbides, but up to the present time they are in the experimental stage, and it can be safely stated that the entire use for calcium carbide is for the production of acetylene. Acetylene principally as a name is older even than carbide. It was first made by Sir Humphrey Davy in 1836. Its first production, too, was incidental to an attempt to produce metallic calcium from a mixture of calcium chlorate and charcoal. Acetylene occurs as a very small fraction of 1 per cent. in ordinary coal gas. It is produced when a Bunsen burner snaps back and lights at the mixer. It can be gotten by causing an electric spark to pass between carbon points in an atmosphere of hydrogen; it can be produced by passing hydrogen through a white hot carbon tube. In 1876, at the Centennial Exposition, Philadelphia, two gallons of alcohol were exhibited which had been made from acetylene extracted chemically from a great many 1,000 cubic feet of illuminating gas. All of the above processes of making acetylene are merely chemical possibilities. There is only one commercial way of producing acetylene, and that is by the mutual decomposition of water and calcium carbide.

Acetylene is a colorless and tasteless gas. When chemically pure it has a sweet, etheral odor, but in the commercial form it carries small percentages of phosphoreted and sulphureted hydrogen which give it a strong pungent odor. One cubic foot of acetylene weighs .069 pound; 13.85 cubic feet of acetylene weigh 1 pound. One cubic foot requires 11.91 cubic feet of air for its complete combustion. Acetylene has a gravity of .92 (air being 1) which is very nearly as heavy as air.

Acetylene contains 12 parts carbon and 1 part hydrogen, or 92.3 per cent. carbon and 7.7 per cent. of hydrogen. It is the nearest approach to gaseous carbon, and it possesses a higher candle power than any other substance which is known or recognized as possible in chemistry. It is an endothermic combination and possesses the extraordinary candle power of 240 candles for 5 cubic feet. It is soluble in its own volume of water, and in varying proportions in ether, alcohol and turpentine and to a very large extent in acetone. It liquefies under a pressure of 700 pounds to the square inch at a temperature of 70° F. The pressure necessary for liquefaction varies directly with the temperature up to 98°, which is the critical temperature for acety-

lene, beyond which temperature it is impossible to liquefy the gas at any pressure.

When calcium carbide is brought into contact with water, the calcium of the carbide, which possesses a greater affinity for oxygen than the hydrogen which forms a part of the water does, robs the hydrogen of its oxygen and forms lime and thus sets the hydrogen free. At the same time that the calcium of the carbide combines with the oxygen of the water, it liberates its loosely held carbon, and this carbon of the carbide and the hydrogen of the water being nascent, and having nothing else with which to combine, unite and form acetylene. The primary reaction is the formation of lime with the formation of acetylene incidental, but as wheat may sometimes be threshed for the chaff, so in this instance the by-product is of value and is saved, while the body, which furnished the energy for the reaction, is thrown away in the water in the form of slug.

Sixty-four pounds of calcium carbide combine with 36 pounds of water and produce 26 pounds of acetylene and 17 pounds of residue. This residue is very pure, slacked lime, and may be used for whitewashing, mortar making, fertilizing, disinfecting or any other purpose for which lime is ordinarily employed.

Chemically pure calcium carbide will yield at 70° F. 30 inches mercury, 5.83 cubic feet acetylene per pound of carbide. Commercially pure carbide is guaranteed to yield 5 cubic feet of acetylene per pound and usually exceeds the guarantee by a few per cent.

The reaction between calcium carbide and water, and the subsequent slacking of the calcium oxide produced, give rise to considerable heat, which is the principal foe of the generator designer. This heat from one pound of chemically pure calcium carbide amounts to sufficient to raise the temperature of .49 of a gallon of water from the freezing point to the boiling point.

While acetylene is not affected by any degree of cold, temperatures in excess of 536° F. cause it to polymerize or to combine with itself, to double up rather than to break up, and changes of great chemical complexity begin to take place in the structure of the gas. If the acetylene is once raised to this temperature no amount of subsequent cooling will undue the damage which it sustains.

All acetylene will contain traces of oxygen, hydrogen, ammonium, sulphur and the two hydrogen combinations mentioned

above. With the pure materials used in the manufacture of American carbide purification of the gas is not necessary, especially if the gas is generated in a wet machine where the gas is to a very great extent scrubbed of its sulphur and ammonium compounds by bubbling through the water and lime in the generator. Such, however, is not the case with carbide of foreign manufacture, which contains phosphoreted hydrogen in sufficient quantities to form a white haze around the burner where the ventilation is insufficient for the removal of this. The gas may be scrubbed for the removal of these impurities with any kind of a strong oxidizing agent, such as bleach; or better with chromic acid which forms the base of most of the chemical purifiers on the market.

Owing to the extreme richness of acetylene, burners for its consumption are unique in design. They are built with a view to supplying an amount of air which with other gases would be in excess. They are made by the employment of two Bunsens, from which the streams of gas impinge on each other and form the luminous part of the flame in the air, and of contact with any part of the burner.

When it is considered that the only thing necessary for the production of acetylene is the simple contact of calcium carbide and water, and that the necessary and inevitable result is the immediate evolution of quantities of acetylene varying only in direct proportion with the quantity and purity of the two bodies concerned in the reaction, it would seem that very little scope was afforded to the mechanical ingenuity of the inventor in devising means by which the necessary contact between the two interacted bodies can be brought about; but a glance through the patent files of the last 5 years, through the advertising columns of the trade journals, or the list of over 100 generators—all different, which has been passed by the various boards of underwriters, will prove that such is by no means the case.

Unfortunately a number of designers of acetylene apparatus, who while undoubtedly possessed of a high degree of ingenuity and mechanical skill, had but little idea and less definite knowledge of the properties of one of the bodies with which they were dealing, and as a result many generators were arranged with little regard to safety, and while they did generate acetylene, they made the gas in anything but its purest form, and many

gave a far smaller yield of gas of probably a lower candle power per unit of carbide consumed than could have been gotten from the same carbide by some machine otherwise constructed upon more rational principles. The weak points in the early designs soon made themselves evident by leaks, by unsatisfactory light, by high cost for light, and in some instances by explosions.

There are two types of generators; one in which a varying quantities of water is dropped onto the carbide, the other in which the carbide is dropped into a large excess of water. The first class may be subdivided into the machines in which the carbide is dipped into the water and then withdrawn, or in which water is caused to flood a mass of carbide and then to recede. Owing to the large amount of heat generated by the reaction, and the susceptibility of the acetylene to heat, the first, or dry type, is confined to lamps and to small machines.

There are two ways of getting rid of this heat of generation, and the degree of success attained in a very large measure determines the success or failure of the generator.

The first is by dissipation into the surrounding air, and the second is by absorption in water. Dry machines depend upon the first principle; wet machines upon the second. A few small machines such as bicycle and automobile lamps, etc., depend upon the first principle; all large machines upon the second. The underwriters require provision for one gallon of water for every pound of carbide, and as it requires only 0.56 of a pound, or a little over ½ pint of water for the chemical reaction, there is ample water left for the absorption of the heat, and the possibility of danger, or rather of annoyance and expense from overheating, may be considered as out of the question with any approved acetylene generator of the wet type now on the market.

Acetylene possesses very great enriching qualities for ordinary gas. Each 1 per cent. added to ordinary gases will give an increase of 2 candle power, and it is practicable to obtain a higher candle power in this way than is possible by any other means, but in price acetylene cannot compete with oil, gasoline or cannel coal, as an enricher for candle power within their range.

Acetylene contains 1,685 B. T. U. per cubic foot as compared with 1,000 for natural gas and 600 for coal or water gas. And while the illuminating value of acetylene is from 10 to 15 times

that of ordinary gas, excepting for small uses, acetylene is neither a power, a heat nor an enriching proposition.

At the present state of development of the acetylene industry, and of the art of calcium carbide manufacture, this gas will not compete with coal gas or water gas, or with electricity as supplied in our cities. It has a field of its own, in which field it is unique and fills a long felt want. For isolated domestic or commercial lighting, such as farms, drug stores, lodges, churches, groups of houses, factories, summer resorts, and in towns and cities of less than 5,000 inhabitants, etc., it leaves nothing to be desired. The modern generators have been worked out with great skill and they are very satisfactory. They have been passed upon by the Board of Fire Underwriters, who consider them safe enough to be given a lower insurance rate than is accorded to kerosene or other forms of illumination which they supplant.

There have been accidents with acetylene, but when it is remembered that of the machines now in use, operated for the most part by people with a minimum of mechanical ability, and an absolute ignorance of gas making, it will be granted that the proportion has been very small, and in almost all instances the accidents which did occur have been the result of the gross carelessness or of the needless ignorance of the persons having the plants in hand, and in almost all instances were the results of the old combination familiar to all gas men—the fool, a leak and the light.

Acetylene may be stored under pressure for railway and other portable lighting, and it may be absorbed in acetone and used for the same purpose. It is so used now under the first system in about 300 cars now being lighted under the well-known Pintsch system of gas storage. The second system is being experimented with and is making quite some headway.

For lighting towns too small for water or for coal gas, or for those parts of larger places not now reached by the regular mains, acetylene is very well worth the attention of the gas fraternity. Acetylene offers the one practicable and profitable method of lighting towns of less than from 3,000 to 4,000 inhabitants. That it is successful in lighting the smallest as well as the largest of these towns is shown by the fact that of the more than 200 acetylene plants now in operation, about 75 per cent. are in towns of between 500 and 2,500 population.

The principal reasons for the success of acetylene in this field are the low first cost of the plant, simplicity of the production, small cost of maintenance and repairs, and the economy of the light furnished. Such is the high candle power of acetylene that only one-tenth of the volume of this gas is required to produce a given candle power as compared with the volume necessary when other gases are used. This means that in a town where ordinary illuminating gas would require a holder of 10,000 cubic feet capacity to supply one day's requirements, a holder of only one-tenth the size would be necessary if acetylene is used. The same reasoning applies to the size of mains.

Acetylene being a true gas, and containing no condensable constituents, it is not affected by temperature changes within atmospheric limits, and hence it is not necessary to lay mains deeper than just sufficient to protect them from cart wheels or other mechanical harm. It is possible to install an acetylene plant at considerably less than the cost of installing a plant for any other kind of gas, or to install an electric light system.

By simplicity of production is meant the simple manner of generating the gas by the mere process of bringing carbide into contact with water. Neither expert labor nor the services of a superintendent is required. A man of ordinary intelligence, after a little instruction, can successfully operate a town plant and only about 1 or 2 hours' labor each day are necessary to take care of an average plant in a town of from 500 to 3,000 inhabitants.

While automatic generators have been used for making and supplying gas to mains direct, the use of such method is not advisable for obvious reasons, and the largest and most successful systems of town lighting are those employing storage holders large enough to supply the maximum consumption of any 24 hours. The generator used by the United States Government at Fort Meyer, Va., and Chickamauga Park, Ga., two large acetylene systems, and by the majority of the largest town lighting plants in this country, is a heavy cast iron and boiler plate apparatus which feeds a limited amount of carbide into an excess of water by means of a screw conveyor, the conveyor being driven either by hand or by a small water motor.

A feature that is unique in producing acetylene is that the cost is not dependent upon the quantity of gas generated, as no fuel

or materials other than carbide and water are required. Acetylene may be produced in small quantities at quite as low a cost as it can be made in large volumes. Statistics gathered from various acetylene plants that have been in operation for one or more years show that plants properly built earn from 6 to 30 per cent. on their cost, while the gas is sold at a price that is quite satisfactory to the consumers.

The growth of the acetylene town lighting plants has been phenomenal. In 1898 there were 4 plants; in 1899 there were 8; in 1900 there were 30; in 1901 there were 39; in 1902 there were 60; in 1904 there were 202, and since the beginning of the present year a number of new ones have been started.

In addition to the town lighting plants there are now in operation over 80,000 isolated plants supplying from 10 to 2,000 burners; there are bicycles and automobile plants without number and there are several thousand table lamps supplying a magnificant reading light where it is not obtainable otherwise.

As to a supply of carbide, The Union Carbide Company has two large works, one at Niagara Falls, N. Y., and one at Sault St. Marie, Michigan. It has a warehouse for the distribution of the products in Portland, Oregon, and one in Portland, Maine. It has one in Minnesota and one in Mississippi. It has one in Carolina and one in California. It has one in Maine and one in Texas. It has six on the Atlantic, two on the Gulf, three on Pacific, two on the Mississippi, two on the Lakes and at least one in almost every State between.

I bought some apparatus which was loaned me by different dealers in these lines around the city, and here are some samples of the different commercial sizes of carbide. The different types of generators require different sizes of carbide. The large ones, which feed the water on the carbide, use this coarser crush. The coarser the carbide the better, as it is possible to get a little more gas out of it. Those which require the flowing of the carbide into the water have to have the smaller sizes to keep it from arching. The carbide runs in these different sizes, from the sizes required for the largest generators down to this size, which is about like rice. This small size is used in these lamps and in several other types of machine which move the carbide to the water, instead of the water to the carbide. These different sizes are for different purposes, the quality is the same. These are

automobile lamps. They were loaned me by the Hind-Walker Manufacturing Company, of Chicago, who deal in them in this city. Some of these have the acetylene generator in the lamp, and some have the generator apart and connected to the lamp by hook. That is a bicycle lamp, this a portable table lamp. These are probably the smallest gas plants in existence. This is one with the generator in the back. With these table lamps, the bottom is filled with water and the top with carbide, the gas is made by introducing the carbide into the water, a diaphragm here controls the flow of carbide automatically to the burner. These use this form of carbide. There is a good many thousand of them out. There is a diaphragm there, a valve here, a constricted place in there, and the valve is hung by means of a stem to the bottom of this diaphragm. The valve is like a mushroom, and the carbide lies above. Here is the water in the bore. When you start it you generate gas which fills the receptacle and raises the diaphragm. When the diaphragm raises it shuts off the carbide from the water. There is a little governor in there which maintains an even pressure of gas at the burner. As you burn the gas out the diaphragm collapses, as it comes down it opens a little space between the valve and the seat, and the carbide flows down in here. As the gas is generated it fills the diaphragm, and raises it and closes valve again. These two lamps are practically identical. This is a little different in the type of burner. These burners that I mentioned—I have some here, showing the different designs, some of them have as many as six different flames—were loaned me by the D. M. Steward Co., of Chattanooga. This is probably the smallest gas plant in existence. It is an entire gas works. You have got your material there, it does its own labor, and here is your system of mains, from here to there; here is your governor and valve house; here is your consumer. You have no trouble from electrolysis or labor. If I can answer any queries I shall be glad to do so.

DISCUSSION.

THE PRESIDENT—Gentlemen, we have certainly listened to a very interesting paper. In this connection, I would say that while Mr. Morehead's method of speaking would not tend to make any one believe that he was from the South, still he is from

North Carolina, and is the man who discovered carbide. I would like to have a little discussion on this subject. Mr. Pratt.

MR. PRATT Mr. President, I have prepared no discussion myself, but Dr. Harrop, the chemist of the Milwaukee Gas Light Company, handed me this just before leaving Milwaukee to have it read at the close of the paper. I will read it:

Comment by Dr. Harrop.—I do not wish the following to be taken as a criticism of Mr. Morehead's paper in any sense, for I know that he is a pre-eminently able chemist and a first class electrical engineer, and he has been identified with the carbide industry since he installed the original electrical furnaces at Niagara Falls he must understand the subject thoroughly. These notes aim to bring out, in the discussion, information additional to the argument so cleverly made for the acetylene in the paper proper. (1.) The Carbide Company seeks the best lime producing stone and the coke with the lowest ash content, but even then the carbide must fall considerably short of 100 per cent. CaC_2. Pure CaC_2 may generate 5.83 cubic feet of acetylene, and it has been stated that commercial carbide may not generate over 5 cubic feet. What per cent. of the average selected carbide put upon the market is CaC_2? Again, can free carbon or uncombined calcium oxide occur in commercial carbide and how much? (2.) The figures commonly given for the heating power of acetylene range from 1,400 to 1,555 B. T. U. per foot. Mr. Morehead gives 1,685 as the correct figure; this is very similar to that published by Prof. Vivian B. Lewes in his volume "Acetylene." Does Mr. Morehead know that this is the correct figure of his own experience, and it is based on the anhydrous gas? (3.) Is the gas sent out from the best form of generator anhydrous? If not, what per cent. of water vapor does it contain? (4.) The paper states very clearly that carbide will not detonate from any kind of blow or concussion. It is a matter of public knowledge on the other hand that compressed acetylene occasionally does explode—one serious case was reported from South Chicago quite recently. Since the deportment of acetylene under pressure has been studied very thoroughly and in a scientific manner, it would be well to put a summary of these facts on record in the discussion.

THE PRESIDENT—Can we hear from some other gentleman on this subject?

MR. JOHN D. MCILHENNY—I would like to ask Mr. Morehead at about what price the gas is sold in the small town plants that he mentions?

MR. MOREHEAD—The gas is sold by the 100 cubic feet not by the 1,000. It ranges from $1 per 100 to $1.50 per 100, that is $10 to $15 per 1,000. The meters which are used for this have one dial more than the ordinary meters; otherwise they are the same. The ordinary meter does not read closer than 100 feet, which with acetylene would be $1; with ordinary gas at $1 per 1,000 it would be 10 cents. So they speak of it as $1 a 100, or dollar gas, or a $1.50 gas.

THE PRESIDENT—Mr. Lynn.

MR. JOHN R. LYNN—I notice that the author has placed the heat units of coal gas at 600. I think you will find that a good coal gas comes about 650. Furthermore, in a comparison of the holder capacity that would be required, the author of this paper seems to have lost sight of the fact altogether that the greater quantity of the artificial gas sold in the country is sold through the appliances where heat units, and not candle power, are of the greatest importance. I think the main thing for us to consider is that calcium carbide would probably cost about $80 in ton lots, would contain 750 pounds of carbon, would produce a little more than 800 pounds of acetylene—about 11,000 cubic feet—at a cost of approximately $7.20 per 100. When we consider that the greater part of our gas goes through appliances, as I say, where heat units constitute the thing to be considered, I don't see where the gas companies can gain in any way by using calcium carbide or acetylene as an enricher or any other way.

MR. FORSTALL—Taking up this comparison between the holder capacity required for acetylene and coal gas plants, I am afraid Mr. Morehead, like other electrical engineers, has forgotten there is such a thing as a Welsbach mantle. He has compared the acetylene flame at its maximum capacity of 240 candles for a 5 cubic foot consumption with the ordinary flat flame of carburetted water gas, of about 24 candles. Now, I think it is pretty safe to say that the ordinary acetylene flame, as used in practice, burning about ½ cubic foot per hour, does not give light at the rate of 240 candles for 5 cubic feet; in other words, that the ½ cubic foot flame does not give 24 candles. It

is also pretty safe to say that the man who burns coal gas or carburetted water gas in such way as to get less than 25 candles per cubic foot is wasting his money. So that instead of the amount of gas required for a given amount of light, taking it on the light basis, being 10 times as much with carburetted water gas or coal gas as it is with acetylene, it is probably not more than twice as much, so that you cannot reduce the capacity of your holder to one-tenth in an acetylene gas plant. As far as the street mains are concerned the difference is still smaller, because in distributing ordinary illuminating gas we are distributing gas of $\frac{3}{4}\frac{3}{4}$ specific gravity, while in distributing acetylene we are distributing gas of $\frac{3}{0}\frac{3}{8}$ specific gravity. Now, in regard to the man of ordinary intelligence, successfully operating a town plant on only about an hour or two of labor each day. I have seen illuminating gas plants which were run on that basis, and I bought one of them a little while ago for less than its scrap value. The point that I wish to make may not be apparent. It is not that the time should be occupied in operating the plant, but it should be occupied in finding somebody to use your gas.

MR. MOREHEAD—As a matter of fact the Welsbach burner, even if it burns coal gas, will take from 3 to 4½ feet an hour, while with this the burners which are there are burning ½ foot an hour, and in that respect you do use less gas. On the other hand, you can burn acetylene in a Welsbach and get practically the same increase in light. It is only fair to say, however, that the Welsbachs for acetylene up to this time are not thoroughly satisfactory. The flame temperature of acetylene is so high that they don't give the same satisfaction which the open-flame burners do; but there are a number of Welsbach burners using acetylene that are fairly satisfactory. As for the specific gravity, of course, it is twice as heavy, and the gas is rather sluggish just in that proportion, and the mains would have to be somewhat larger than they would if you shifted the same amount of coal gas at the same pressure but at a lower gravity; but it is not anything like 10 to 1 which is the proportion in candle power. Figured in an open flame, as Mr. Forstall very properly says, perhaps ½-foot burner does not give the proportion of 240-candle power. Nor does a small, flat flame, coal gas burner give the proportion of 24 candles, or 18 candles, or whatever a gas company says the gas is that it sells? There is more gas used in

flat-flame burners to-day than there is in Welsbach (cries of "Oh, no.") Well, I think that there is; you cannot argue with me on that point.

MR. J. R. LYNN—Did I understand the gentleman to say that with a mantle light there would be the same proportionate increase with acetylene. The statement will not apply, because there is not the same difference between the primary candle power and the number of heat units per cubic foot that you can get from it. It cannot apply. It is a chemical impossibility.

MR. FORSTALL—I only want to say in response to Mr. Morehead's suggestion as to the candle power of gas not holding out on a flat flame burner, that I always tested the gas I made with a flat flame burner.

MR. MOREHEAD—And he tested it under 6-tenths pressure in a photometer room, without any air draft, and probably changed his photometer burner about every six weeks; if he did not, he should have so done. As far as the candle power with a Welsbach burner varying directly as the heat unit content of the gas is concerned, I beg to differ with the gentleman. The flame temperature of a gas has a great deal to do with the candle power that you get from a Welsbach burner, irrespective of the heat units. You can take blue gas, which has only from 300 to 350 heat units per cubic foot, but which has an enormously high flame temperature, and get very much more than half the heat units out of it that you would get out of a coal gas or a water gas with twice that number of heat units, or with natural gas, which has a very low flame temperature. You could not get anything like 3 times the candle power per cubic foot out of natural gas with 1,000 heat units that you could get out of blue gas with 300 heat units, for the simple reason that it is flame temperature rather than the heat units—not alone, but along with the heat units, which determines the candle power when the gas is burned with a mantle. Another gentleman spoke of the heat units in acetylene. That was determined in Prof. Lewes's laboratory in Greenwich, near London. I did the manipulation of the calorimeter. That is not the reason, however, that it showed so high, but I was there with Prof. Lewes at the time. We did a great deal of work on this in London in 1896; 240-candle power can be obtained from any acetylene if you get all the air out of it. Of course, commercial acetylene contains a little air,

sometimes 2 to 6 per cent. But you can get that out without any trouble.

MR. NORRIS—Mr. Chairman, can Mr. Morehead give us the actual candle power ½-foot per hour acetylene flame? It has been alluded to as being something under 24 or 25 candles, but how much is it actually?

MR. MOREHEAD—It varies very largely with the gas and the condition of the burner. The ¾-foot or the 1-foot burner of the Bray type and of another burner made in this country, will give you the actual 48-candle power per foot, which is 240-candle power for the 5 feet. The ½-foot burner, just as if you got any burner that is small, will give you less in proportion. Instead of giving you 24 candles it will give you 20 to 22. I have frequently gotten that with them on the photometer. On the photometer, with the 5 feet of gas that you use, you use a burner consuming 5 feet. If you had a smaller burner, which burned only 2½ feet, you would not get half of the candle power that you would with the 5-foot burner by a very great deal, and the same thing applies to these ½-foot burners which I have burning here. There are also some 1-foot burners there. You could not tell the difference by looking at the burners, but it is very apparent when you see the flame and its light.

MR. DOTY—Mr. President, I had the opportunity of being associated with Mr. Morehead at the Exposition at St. Louis last year, and I must confess that I became a great admirer of his knowledge of acetylene. The rest of the jurors, and a great many of the gas men I am sure, had no conception of the importance of the acetylene industry in this country, and this is equally true of the importance of the acetylene industry abroad. I think I am correct in stating that in France alone something like 40,000-horse power is daily employed in the manufacture of calcium carbide. I have not the figures for the American production but I know Mr. Morehead has them at his fingers' ends, and I think if he would express to the members the amount of horse power daily used in the United States it would carry a very strong and lasting impression in their minds; and, I understand, the use is growing daily, not as some of the gentlemen seem to think, that acetylene is a competitor of the ordinary city gas industry; rather it is a helper, an introductory means of developing the gas business when the city grows, and therein lies to my

mind one of the most important advantages to our industry of the acetylene industry. They don't need any help from us at all, but we will get a great deal of assistance from them by the introductory or educational work they are doing. I would like to ask Mr. Morehead what amount of horse power is being used daily in the United States, and whether he can give figures for any of the countries beside France.

MR. MOREHEAD—There is in use in this country between 20,000 and 40,000-horse power in the two plants, and with the exception of some of the very large traction companies we use more electricity than any industrial concern in the United States, I don't know but in the world. Of course, in New York the Manhattan and some of those big electric railroads employ more electricity and more power, but for an industrial purpose we use more electricity than any of them. As Mr. Doty has said—he brought up the question—there are a great many towns which cannot be lighted by coal gas or water gas, because they are too small. The question comes up. I have heard of it very often. A man comes to some gas engineer and says, "We want to know whether we can put in a gas plant at this place." The engineer asks, "How many people have you?" and he replies, "Two thousand," "Fifteen hundred," "Three thousand." The engineer says, "It won't pay." Now, it is free to confess that in a town like Chicago or St. Louis or any town of large size, you could not use acetylene, and in the small towns you cannot use water gas or coal gas, but you can use acetylene in those places, and it has a field to itself. It is very well worthy of the attention of the gas engineering fraternity for those places which are not covered by the other fields. Of course, the small generators, of which there are about 80,000, into which you put carbide like you put coal in a stove, hardly apply to the gas engineering fraternity, that is, people who are in the consulting engineering business for gas, but in the smaller towns these plants pay a very good profit. They don't require a great deal of investment, and they are very well worth the attention of the gas people. I don't think the gas fraternity have ever had the matter brought to their attention to the extent it merits.

MR. DOTY—How much horse power is used abroad?

MR. MOREHEAD—About the figure that you said in France. There is a trust there which controls the rest of the power. There

is none in Austria. I think there is about 7,000-horse power in Germany and about 10,000-horse power in Sweden. There was a plant in England which used, I think, about 500-horse power, but that has been shut down now. One little plant in South America is using about 400-horse power.

MR. DOTY—In France more generally?

MR. MOREHEAD—In France more than any other. On the side of the Alps next to France they are using more acetylene than in any of the other European countries. There coke is very bad. It carries a great deal of phosphorus, which necessitates the scrubbing of the gas. Very large amounts of acetylene are used in train lighting. The imperial railroads in Germany and in Austria are lighted with a mixture of it and with the gas pure, and that is one of the largest uses. A great deal of carbide is manufactured in Switzerland.

MR. DOTY—I should like to ask Mr. Morehead if the generators made by the foreign manufactures would pass the underwriters' rules for American practice?

MR. MOREHEAD—They would not. The generator manufacturers are here rigidly held. They have a set of instructions which they require for every generator, and if the generator passes that all right, if it does not it does not. They have turned down a great many generators. Abroad there is a lot of hand work; you control the generator by hand. Labor is very cheap there. The generators are not as well made as ours, and they don't have the safety appliances which the underwriters here require. Now here the underwriters require a gallon of water to the pound of carbide. It is not necessary but it is on the side of safety. A half pint is required for the chemical reaction, but they require a gallon, so as to be on the safe side. Abroad they don't require it. On that one point alone none of the foreign machines would get through the underwriters' examination on this side, which is a great point for safety of the American machines.

MR. DOTY—Would you consider that the state of the art in manufacturing acetylene appliances is ahead in this country of the foreign countries?

MR. MOREHEAD—We are very much superior to them. In fact, we are sending a lot of our apparatus over to them. We get everything that they do. When anything new comes out we

get samples of it here. We are in touch with the progress there, both in the manufacture of calcium carbide and the utilization of it. In the lamps, generators, stoves, engines and things of that sort, they have not anything to teach us.

MR. MILLER—What about the use of acetylene in mechanical operations? I believe there was an installation brought to the World's Fair for the use of acetylene for some mechanical operation; welding, or brazing, or something of that kind. I would like to know what advance has been made in that direction.

MR. MOREHEAD—Acetylene has an exceedingly high flame temperature in addition to its heat units. For welding purposes, and in the attainment of temperatures which you cannot get by means of other gases, it has a field, and it is used to quite an extent. A man in Ohio is making rubies with it. You can fuse almost anything. You can melt platinum with it. By taking acetylene and oxygen you can get temperatures almost up to the fusing point of lime. Now, you cannot get those temperatures with ordinary gas. When it comes to heating a house or to cooking, the expense would forbid its use on a large scale. You cannot get heat with an electric furnace for anything like the same cost that you can get it with coal. But coal would stop at 3,000°, while an electric furnace would go to 6,000°. If you get out of the range that you can obtain with the other gases, acetylene is cheap.

MR. HAINES—What proportion of calcium carbide is used for automobile lighting, and what for house lighting. The figures have been given for France, I think, of 40,000-horse power. I would like to know about what proportion is used there and what proportion is used in this country.

MR. MOREHEAD—It is almost impossible to say. The automobile size of carbide or the size which I have here in my hand, is used for a number of generators, and the proportion used during the year for each month varies enormously with the time of year. As you naturally see, in the winter there is not much used, in the summer there is a great deal. So that I am really unable to say just what proportion is used for generators and what for lamps. In the bicycle days a great deal was used. They required a special size. That was before these lamps came out, and it was before they used that size of carbide in generators, and we were able to keep account of it, to know. I don't happen

to remember the figure at the moment. But now these sizes are all mixed up, so that a man buys 100 cwt. of carbide, and there is no knowing whether he is going to use it in an automobile or for lighting a church, a drug store, a house, a lodge or a summer resort.

MR. JOHN R. LYNN—Mr. President, I should like to ask Mr. Morehead if any acetylene gas is used from these isolated plants for fuel purposes.

MR. MOREHEAD—Quite a little of it is used for fuel purposes. There are stoves for it, and hot plates. I wish I had brought some of them here. They are precisely similar in appearance to the ones with which we are all familiar. They work very satisfactorily. The cost would forbid their use however on a very large scale; on a small scale, for a small amount of cooking or something of that sort, why, you could use them, but it gets rather expensive if you use a great deal of it.

On motion of Mr. John D. McIlhenny, a vote of thanks was tendered to Mr. Morehead for his excellent paper.

PROPOSED GAS ENGINEERING COURSE.

THE PRESIDENT—It has been brought to my attention that we have with us, and I am glad to say as new members, Prof. F. E. Turneaure, Dean of the College of Engineering, and Prof. Charles F. Burgess, of the College of Engineering, University of Wisconsin, at Madison. They are starting a gas engineering course in that University, and I think we would all like to hear from Prof. Turneaure as to what they propose in connection with the course.

PROF. TURNEAURE—Mr. President and Members of the Association, I don't know that I can say as yet what we are going to do. That is what I came down here to find out. I am very glad to be able to become a member of this Association, and in the enterprise that we are entering upon at the University of Wisconsin I expect a great deal of help from your membership. We expect next year to inaugurate at Wisconsin, on a small scale to start with, some work which will lead up to instruction along the line of gas engineering. Just exactly what that means seems to be difficult to find out, even among those who are prominent gas engineers. We shall not begin on a very large scale,

but hope to build up the instruction on solid, substantial grounds, and not attempt to turn out consulting gas engineers after four years' of school. I can only say again, I thank you very much for permitting Prof. Burgess and myself to join the Association, and I trust we will get a great deal of good from our membership. (Applause.)

THE PRESIDENT—Will Prof. Burgess favor us with a few remarks?

PROF. BURGESS—Mr. President, I shall have to be excused at this time. I hope that next year, or later, I shall have an opportunity to address you.

A CALL FROM IOWA.

THE SECRETARY—Mr. President, before we read Mr. Chollar's paper, I wish to make the following announcement: Members of the Western Gas Association from the State of Iowa are requested to meet in Room J, 14, Auditorium Annex, immediately following the adjournment of this meeting, for the purpose of perfecting a State organization.

GEORGE B. MCLEAN,
L. L. KELLOGG,
JANSEN HAINES,
Committee.

The President again called attention to the fact that the photographer was ready to take a picture at the close of this session, and that anyone who wished to be photographed should remain until the close of the afternoon proceedings.

The President then announced that the next paper on the programme was that by Mr. B. E. Chollar, of Kansas City, Mo., on

THE EVOLUTION OF THE ENGINEER.

Owing to Mr. Chollar's absence, the paper was read as follows by Mr. W. E. Steinwedell:

I am asked to prepare something about the engineer—not an essay on engineering, its history or its practice, especially, but a little about the engineer in general; the whence of the engineer; the why of the engineer; the how of the engineer; the now of the engineer, and the hence of the engineer.

The "Century Dictionary," in defining the word engineer,

engineering, etc., says in part as follows: Engineering (verbal noun of *engineer*), the art of constructing and using engines or machines; the art of executing civil or military works which require a special knowledge of machinery, or of the principles of mechanics; careful management or maneuvering. (See engineer, verb.)

Engineer (verb) to plan and direct the formation of; to direct as an engineer as, to *engineer* a canal or tunnel. To guide or manage through or over obstacles by contrivance or effort; as to *engineer* a bill through congress. (See engineer, noun.)

Engine (noun) from the Latin *ingenium*, innate or natural quality; genius; a genius; an invention; in later Latin, a war engine; a battering ram. In old and obsolete English, innate or natural quality; ingenuity; craft; skill. Chaucer says: "I ne userpe not to have founden this werke of my labour or of myne *engin*." Puttenham, also: "Such also as made most of their works by translation out of the Latine and French toung and few or none of their owne *engine*."

A later meaning but still obsolete is an artful device or contrivance; a skillfully devised plan or contrivance or method, a subtle artifice. A more modern meaning is: An instrumental agent or agency of any kind; anything used to effect a purpose; an instrumentality.

"An age when the Dutch press was one of the most formidable *engines* by which the public mind of Europe was moved." —Macaulay.

An apparatus for producing some mechanical effect; especially a skillful mechanical contrivance.

Thus far in the early use of the word *engine* the connection between natural born ability and war engines and battering rams is not clear. The Bible, however, sheds light on the matter. The 26th chapter and 15th verse of Second Chronicles (speaking of King Uzziah) says: "And he made in Jerusalem engines, invented by cunning men, to be on the towers, and upon the bulwarks to shoot arrows and great stones withal." The word cunning in the time of King James I. had a more respectable meaning than it has at the present time. Cunning is literally knowing, and especially knowing how. It is from the same origin as the word can (in obsolete form con or to con), to know; later to know how to do; to be able to do.

Hence we may infer that the original engineer was a man of natural ability and who knew how to do things. His principal work in early times was probably to furnish brains for kings, to show them how to win their battles, to fortify and capture cities, to build their roads and bridges, and to move their armies.

The civil engineering of the ancients was not great. The demand for transportation was small, yet they built canals, but knew nothing of locks; they knew little of mechanics and less of hydraulics. They had no big pumps, hence no big mines. They built aqueducts and ditches, but knew little about the flow of water.

The ancient speculative philosophers were not conductive to the development of technical engineering. Their philosophy was mental gymnastics. They didn't experiment. They asserted, but did not prove. They generalized and concluded from individual cases. They reasoned, each man for himself, and there were about as many kinds of philosophy as there were of philosophers. One man, for instance, thought there were 4 primal elements. Another thought water to be the ultimate matter, while another didn't believe it was water but was air, because air gives life and is infinite. Democritus thought the world was made of ultimate atoms, but the atoms that Democritus had in his mind were not the atoms of Dalton.

The ancient philosophers were thrifty; they taught for money. They got as many pupils as possible, and tried to make them believe as they did. Their thinking power was immense, but it was not the power of doing things. They lacked the how, and were not engineers. Fortunately there were a few men of another kind. Archimedes did things. He was an engineer, a military engineer. He was engineer-in-chief to the king, and helped to defend Syracuse from the Romans. He experimented. He found out not only that the king's crown had been "faked," but also how much silver had been substituted for gold. He invented the lever, and offered to take the contract to move the earth provided somebody wonld find him a place to stand. The mediæval philosophers were as bad as the ancients. The scholastics held sway for 1,000 years. They argued and argued; they fought and fought—they worse than fought, they "scrapped" about the difference between tweedledee and tweedledum, and the world was no better off for them.

During the 15th century things took a change for the better. Copernicus found out for sure that the earth and planets revolve round the sun. He knew how to do it, and did it. He was an engineer: not a technical engineer in the modern sense, but he was a great engineer all the same. Kepler verified Copernicus, and demonstrated the three great laws. He knew how to do things, and was the greatest of all engineers up to his time.

Galileo was an engineer. He did things. He discovered the moons of Jupiter, worked out the pendulum, confirmed Copernicus, and helped Newton on his way to the law of gravitation. Boyle and Mariotte were engineers. Torricelli was an engineer. He found out what makes a pump work, and Pascal verified him. The 16th and 17th centuries were great for doing things. The road to modern technical engineering was built during that time. Everybody that knew anything seemed to be at work.

Bacon, though not a scientist, was the grandest engineer of all. It was left to him to reorganize philosophy, and put it on a dividend earning basis. Before his time physical science was sporadic and desultory. Bacon held that all science is physical science, and is based upon experiment. Conclusions drawn from experiment, although they may be false and fail even in the long run, will lead to other and similar conclusions, so that in the end the errors will correct themselves, and finally the true conclusions will be arrived at. A few had used methods similar to Bacon's before his time, but Bacon completed and published the inductive method to the world.

The greatest of all great engineers in the modern sense of the word was James Watt, who produced that mighty engine that started the wheels of industry agoing and which will keep going as long as time lasts. He made all engineering possible. He did more, he made the impossible not only possible, but easy. Words fail to detail and the human mind fails to comprehend the good that the invention of Watt did for civilization. Watt furnished the mechanical power, and that other gigantic engine, the joint stock company, backed by the brains of the business engineer, furnished the financial power that has moved the world.

Up to Watt's time the universities and colleges recognized only three learned professions—Law, Theology and Medicine. Law was present practice of past experience. Theology was present consideration of the future state. Medicine was the practice of

making people think they knew all about something that they know very little of. Attorney means proxy, priest means an old man, and doctor means a schoolmaster. They were not engineers; they did not do things. The modern physician and surgeon are engineers; the physician is a natural philosopher, and the surgeon is a hand worker. There was a demand for trained engineers who could not get their education at the colleges, but had to go elsewhere. The engineer had no standing then, but now, like Abou ben Adhem, "his name leads all the rest." For many years technical engineers were self-educated, but eventually the demand became so great that technical schools were established in Europe, and up to about 1825 an American who wanted a technical training had to go to Europe for it. The Rensselaer Polytechnic was established about that time, and was quickly followed by others. At the present time there are hundreds, but not enough. The great demand in this country for technically trained engineers dates from the time when iron could be produced profitably. The next great, and greatest demand came with the invention of the electro-magnetic dynamo. The technical schools are turning out young engineers by thousands, and yet the demand for good men exceeds the supply.

The young engineer must know how to do things and to do them well; to that end he must be educated. Education implies information, instruction, teaching, training and learning. By information you know more, by instruction you understand more, by teaching you learn to do things better, by training you learn how to act better. You can buy information, you can buy instruction, you can buy teaching, you can buy training, but you have to learn for yourself. You can't buy learning; you must work for it.

In these days, when the world is moving in geometrical progression, there is little chance for handmade education to compete successfully with the big educational engines. The student had better work at something else to enable him to buy his education than to attempt to make it himself. The technical schools have the instructors, the teachers, the trainers, the appliances; in fact, they supply everything except the work. If the would-be engineer has not got the innate ability he had better keep away from a technical school and take up some other line of business or if he expects to succeed without hard work he had better keep out.

The colleges complain of the bad spelling of their students, and the technical schools complain that many of their graduates are unable to write a report in decent English. It behooves the student to get a good English education to begin with, and not to spend his time and money to get the three R's in a college. Work hard, but don't cram. Don't make notes on your shirt cuffs for examination Nothing is hard when you understand it. The schools will push you too hard and you must work all the harder for it. Don't think you are educated the moment you get your diploma; you will have then only found out how little you know. Diploma means a folded paper. A diploma is only a letter of recommendation. Be careful how you use it, lest you cast discredit on the giver. You will probably use it only once; the next time you will try for a letter from the "boss." It will be better. Keep on reading and studying. You will forget your information but not your knowledge.

An engineer is not much of an engineer when he is only an engineer and nothing more. He must be an engineer and a good deal more. An engineer is the man who knows how to do things and many things.

DISCUSSION.

THE PRESIDENT—Gentlemen, any discussion upon this paper? Being of a philosophical nature, possibly it does not admit of very much discussion.

MR. MAGEE—Is it in order for a visitor to say a word here?

THE PRESIDENT—We would be very glad to have you do so, Mr. Magee.

MR. MAGEE—I would like to know what the opinion of the engineers present is on the engineering courses offered in correspondence schools. There are a great many young men who have had no opportunity for a technical education, some of whom have hardly a high school education, and yet they want to learn more about the inside of the gas business. Some of them are thinking of taking up the correspondence school courses. I would like to have an expression from the engineers here as to the value of those courses.

THE PRESIDENT—I think Mr. Magee's question has quite a pertinent bearing upon this paper, and I would like to hear from some of the engineers present in regard to these correspondence

schools that Mr. Magee is inquiring about. Mr. Doty, will you give your opinion on the subject?

MR. DOTY—It is rather difficult to express an *ex cathedra* opinion, or an opinion based absolutely upon the facts. I have had some experience with correspondence schools, and especially in directing young men who have taken their work. I think in general they are good. Of course, it can safely be said that there is room for improvement in them. It was rather difficult sometimes to get exactly at the work these correspondence schools are trying to do, so far as their application to gas engineering is concerned, but I am a firm believer in education generally, and all education is good. It seems to me almost impossible to get education, even by these correspondence schools, that is not good. The American Gas Light Association is conducting a Correspondence Class in gas engineering which, to my mind, is far superior to the work that is carried on by the correspondence schools. The work is directed with much more intelligence; I think that there is less padding. The chief objection I have to the correspondence school instruction papers that I have seen is so much padding; but that may be necessary. They probably knew the class of students a great deal better than I do. It seems to me that young men can get information from the Correspondence Class of the American Gas Light Association that will be far more valuable to them than they can get from the correspondence schools such as I imagine the gentleman has in mind; but I would not let the impression get out that I discourage any of the schools. The correspondence school is better than nothing. If you cannot get the advantages of the Educational Class of the American Gas Light Association, take up the work of the correspondence schools. It probably will cost you more money, and you will be longer in getting the information you want; but the mere fact that you are trying to do something will lead on to something better, and you will soon get a grasp for yourself from your association with the industry, if you are engaged in the industry, and from association with the men who are doing the work in the industry, that will lead you on and up. I think we are greatly indebted to Mr. Chollar for his paper. As the President has said, it is to a certain extent a philosophic paper. We who know Mr. Chollar know him as an engineer of ripe experience and mature judgment, and he is an engineer in the

sense of the man who does things. Mr. Chollar, more than that, is an engineer by diploma. It is not necessary for me to state that Mr. Chollar graduated from the University of the City of New York shortly before the Civil War, and rendered services to his country during the war in the engineering corps. This we know. He has spent a lifetime in engineering work, and has freely given of his knowledge, freely made sacrifices of his time, for the advancement of Association work. I believe that Mr. Chollar has the proud distinction of being the man who has written the most papers for the different gas associations, and I am sure that we should give the greatest heed, pay the greatest attention to the wisdom, the ripe, mature wisdom, the good, kindly expressions, a man like Mr. Chollar can give us. It will be probably an encouragement for the professors who came here from the University of Wisconsin to know that there are in the gas industry engineers like Mr. Chollar, who can give their thoughts to us, and we can profit from the study and absorption of the thoughts given.

MR. NORRIS—Regarding correspondence schools, I have naturally come more in contact with the work of the Correspondence Class of the American Gas Light Association than the correspondence schools such as that at Scranton, but it so happens that at one of our small works in New York State it seems to be the thing for our men to join that Scranton school. It may be a coincidence, and it may be the result of that, but that one little place has turned out more foremen for other works, more superintendents of little places, than I think all the rest of the Class put together. I don't know whether it is the influence of the superintendent there on those men, but I suppose he has half a dozen men right along who take the correspondence courses at the Scranton school, and it seems to be very effective in enabling those men to rise to a certain point. Of course, the work of the Educational Class of the American Gas Light Association is a little bit more ambitious than the courses taken by these men, and requires more study, and carries the men further in the long run. I thought this experience, such as it is, might have some bearings on Mr. Magee's question.

MR. FORSTALL—In moving a vote of thanks to Mr. Chollar for his paper, I would like, with the permission of the Association, to ride a little hobby of mine for a minute or two. Mr.

Chollar says it behooves the student to get a good English education to begin with. I think possibly I have expressed myself to this Association on the subject before; I certainly have to other Associations. To my mind, the great fault of the ordinary engineering education is its narrowness. It tries to teach a man a lot of stuff, if I may be allowed to call it so, which is supposed to be practical, and I have known quite a number of college students who objected to things in their course which were supposed not to have practical bearings after they got out of the university or the college. You will find, however, by looking over and reviewing the career of the successful engineers, that they have not been the men whom the college has attempted to train in a specialty; they are the men who before entering business life have had a broad training, that covered a number of subjects, and have specialized after they left college. For that reason I am always a little skeptical when I hear anybody advocate the starting of a course in gas engineering as an undergraduate college course. All that a good gas engineer or a good electrical engineer needs is a good course in mechanical engineering. Or I may go even farther than that and say that you can probably make a better gas engineer or a better electrical engineer out of a man who has had 3 years of an academic course, leaving out possibly the Greek and Latin, and then has taken 1 year or possibly 2 years of a mechanical engineering course, than you can make out of a man who, without any preparatory general education, has gone to a technical college and taken a strictly technical course of 4 years. I would like to move a vote of thanks to Mr. Chollar for his paper. [Seconded.]

THE PRESIDENT—Before putting the motion, I wish to say that I am both surprised and pleased at the amount of discussion which the paper has brought forth, and at the thoughtful discussion that has been rendered on the subject of the engineer. [The motion was carried.]

The Secretary read the following

TELEGRAM FROM MR. H. L. DOHERTY:

James W. Dunbar, Secy. Western Gas Association: Much to my regret it will be impossible for me to attend the 28th convention. My best wishes for a highly successful convention, and a

plea for favorable action on any matter which comes up aiming to secure better Association work, which will prove beneficial to the fraternity. HENRY L. DOHERTY.

THE PRESIDENT—Gentlemen, there being nothing further on the programme, we will now stand adjourned until tomorrow morning.

SECOND DAY—MORNING SESSION.

The Association reassembled at 10:35 A. M., Thursday, May 18, 1905. The President having called the meeting to order, announced that the Secretary would read a

SUPPLEMENTAL REPORT FROM THE BOARD OF DIRECTORS.

CHICAGO, May 18, 1905.

A meeting of the Board of Directors of the Western Gas Association was held at 10 A. M., May 18.

On motion of Mr. Doty, it was voted that Prof. Frederick E. Turneaure, Dean of the College of Engineering, University of Wisconsin, Madison, Wis., and Charles F. Burgess, Professor of Engineering of the same University, be transferred from associate to active membership.

On motion, the report was unanimously adopted.

The President introduced Mr. K. M. Mitchell, of St. Joseph, Mo., who read the following paper on

KANSAS OIL.

The story of Kansas will never grow old. Across its prairies have come strange tales in the years gone by; political, religious social revolutions have followed one another, sometimes with startling suddenness. Kansas has never failed the public with something new, something novel something worth while. Many years ago it was "Bleeding Kansas." The writer recalls the time when he viewed wagon after wagon passing through St. Joseph (which is situated on one side of the Missouri river, with Kansas on the other side) into Kansas. I remember one wagon had painted on the side of the canvas-covered top the following inscription: "Kansas or bust." Six months later the same

wagon made its way back into Missouri with this inscription on the cover: "Busted by gum." Missouri took care of the refugees; gave them food and shelter.

Kansas struggling a few years ago to pay off a heart-breaking load of indebtedness, is alive to-day with the hums of factory wheels, the flare of furnaces in foundry and glass plants, brick yards and smelters, flour mills, sorghum mills, cotton mills, operated at a cost for fuel infinitesimal when compared with those 200 miles away. Kansas has an oil and gas field larger and better than any west of Indiana, excepting only California. Kansas has the goods ready to deliver. The oil and gas belts run in a southwest direction across the southeastern part of the State.

Wilson county was the scene of the first oil and gas development. George W. Chase, a teacher in the Deaf and Dumb Asylum, at Olathe, in 1888, visited friends in Wilson county. Chase thought Wilson county likely to be the crust above great oil and gas deposits, and did all he could to awaken the interest of men with means, and while he failed to arouse the people of Neodesha, he accomplished the desired result in other counties. Gas was found at Cherryvale, in Montgomery county. In December, 1892, William M. Mills, of Osawatomie, discovered oil adjoining the town site of Neodesha, on the east.

He formed a partnership styled Guffey, Galey & Mills. They leased large tracts of land (700,000 acres) in Wilson, Allen, Neosho, Bourbon, Woodson, Elk and Montgomery counties. These leases were not much different from those made nowadays.

They gave to the company the privilege of drilling on the land for ten years; they provided for a royalty of 25 cents an acre each year, to be paid if drilling was not begun within 2 years, and they contained a promise to pay the landowners one-tenth of the crude product stored in tanks. If gas and not oil developed, the landowner was to receive free light and fuel for domestic use and $50 a year for every well utilized by the lessees.

The first real valuable gas well drilled was in 1893, 3 miles northwest of Neodesha. Fifteen wells were drilled that year, 13 of which were oil producers. In 1895 they built 2 steel oil storage tanks, with a capacity of 35,000 gallons each. Into these tanks they piped the crude oil which had accumulated in numerous small tanks.

In 1895 Guffey & Galey were absorbed by a company known to the world as the Forest Oil Company, which was in reality the Standard Oil Company. In January, 1897, the Forest Oil Company became the Prairie Oil and Gas Company, and in the following June a refinery was built, which had a capacity of 500 barrels a day, and it treated the product of the company that owned it. The pumping was done with the "shackle-rod" system, a device arranged on the plan of eccentrics, whereby a dozen or more wells may be pumped from one wheel, the rod extending from all sides of the power house, and being supported on posts. One man could care for the engine which burned gas. The farmer got his portion, but hardly fair compensation from the men who were making money while the farmer plowed and harvested the lands that were yielding independence to others.

The average depth of the well in Wilson county is 850 feet. From 2 to 3 weeks is required to drill, and the cost varies from $1,800 to $2,800, the latter figure including the string of tools.

The developments in the Chanute oil and gas fields are very extensive. The country is a forest of derricks, power plants and pumping stations. Mr. I. N. Knapp, a well known gas man, now of Chanute, Kas., is a large producer. He has over 80 wells producing oil. He furnished the Kansas City, Missouri Gas Company, Kansas City Nut and Bolt Company and the Omaha Gas Company with oil for a number of years. He said to the writer in a letter of May 1, 1901: "Kansas oils have no appreciable amount of sulphur, and in this respect are superior to oils from the Ohio fields. There is no practical difference between the Kansas and Ohio oils so far as the enrichment of water gas is concerned. I have sold over 100 tank cars of oil for gas making purposes, and I know from analysis and working tests that the above statements are correct. Yours very truly, I. N. KNAPP."

The Prairie Oil & Gas Company began laying a large pipe from the oil fields in Kansas to its new oil refinery located at Kansas City, Mo. This line is now completed, and the refinery is in operation. The Prairie Oil & Gas Company (which is owned by the Standard Oil Company), laid its pipes to every producer who had a fair production of oil, paying them 31 cents to 72 cents a barrel, according to the gravity of the oil. Oil whose gravity was 22 to 28 brought 31 cents a barrel, and that with a gravity of 32 brought 72 cents a barrel. The result was that the production was tremendous—too great to be handled by

the Standard Oil Company; then came a reduction in the price. Trouble began. The Legislature of the State of Kansas took a hand, and will build a State oil refinery. A number of independent refineries are now being built by the producers who have banded together.

The Standard Oil Company will take only a portion of the highest grade of oil. The indications are that the producers will be compelled to purchase tank cars to transport the oil to the market, which will be sold for gas and fuel purposes.

The Webster Refining Company, of Humboldt, Kas., is an independent refiner of oil and has been doing business for 2 years. We have used the oil from this refinery since June of last year, and find the gravity to vary from 24° to 28°; 4.27 gallons of oil are required to produce 1,000 cubic feet of gas, with a candle power of 22. The coke used is 35.4 pounds; the analysis of the oil was made by the Laclede Gas Light Company, St. Louis, Mo., and is as follows:

Distillation Test made March 9th, 1905, Webster Refining Company, Humboldt, Kas.—Specific gravity of sample at 60° F., 27.3° B. Fraction 10 per cent. by volume.

		Sp. Gr. Baume.	
1st Fraction	95° C.	160° C.	40.1
2d "	160 "	190 "	
3d "	190 "	250 "	32.5
4th "	250 "	265 "	
5th "	255 "	270 "	31.5
6th "	270 "	278 "	
7th "	278 "	305 "	30.5
8th "	305 "	340 "	
9th "	340 "	360 "	
10th "			

Coke (by weight) 3.20 per cent. The last 3 fractions have an odor like kerosene.

Distillation Test made March 8, 1905, on Oil from Neodesha, Kas.—Specific gravity of sample at 60° F., 32.80° B. Fractions 10 per cent. by volume.

		Sp. Gr. Baume.	
1st Fraction	95° C.	201° C.	52.1
2d "	201 "	298 "	38.8
3d "	298 "	320 "	33.9
4th "	320 "	347 "	30.4
5th "	337 "	350 "	29.5
6th "	350 "		29.0
7th "			27.9
8th "			27.8
9th "			27.0
10th "			26.9

Coke (by weight) .98 per cent. The average sediment in a series of samples showed .72 per cent. by volume.

[illegible] from [illegible] F., 31.50° B.

[illegible]

[illegible] per cent.

[illegible] is thick and on cooling

[illegible] it stops flowing at

[illegible]

[illegible]

[illegible] Fuels, Ass.

[illegible] Fractions 10

[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]

Coke (by weight) 2.10 per cent. The last 5 fractions were light colored when first distilled, but on standing turned to a very dark color.

Distillation Test made June 23, 1904, on Oil from Whiting, Ind. —Specific gravity of oil at 60° F., 35° B. Fractions 10 per cent. by volume.

		Sp. Gr.	Baume.
1st Fraction	60° C.	175° C	58.2
2d "	175 "	265 "	44.5
3d "	256 "	294 "	39.5
4th "	294 "	315 "	37.0
5th "	315 "	330 "	35.5
6th "	330 "	337 "	34.7
7th "	337 "	340 "	33.7
8th "	340 "	360 "	31.9
9th "			29.0
10th "			

Coke (by weight) 1 per cent.

Distillation Test made April 14, 1905, on Oil from Indian Territory.—Specific gravity of sample at 60° F., 32.8° B. Fraction 10 per cent. by volume.

	Spr. Gr.	Baume.	
1st Fraction	85°	140°	39
2d "	140	225	
3d "	225	285	42
4th "	285	316	
5th "	316	354	32
6th "	354	360	
7th "	360		28
8th "			
9th "			
10th "			

Coke (by weight), 1.82. Fraction clear.

The daily oil production in Kansas, before the Standard Oil Company curtailed its purchases, was in the neighborhood of 25,000 barrels, oil of all gravities. The sales were only 8,500 barrels and this great surplus was stored in large tanks on the fields. The Standard Oil Company will now take only oil with a gravity of 30° and over. The low grade oil is not being purchased and the producers of oil of a gravity less than 30 are wondering what they will do with their production.

THE PRESIDENT—Before discussing this paper we will hear the paper on Texas oil, by Mr. Thomas D. Miller. The two topics being so closely related, I think we had better discuss the two papers at the same time.

The President introduced Mr. Thomas D. Miller, of New Orleans, La., who read the following paper on

TEXAS OIL FIELDS.

"PETROLEUM, CAPTAIN?"

"Yes, sir; the country was full of it. Isaac knew all about it. You read the Bible."—The Captain's Story—Mark Twain.

The existence of petroleum in Texas seems to have been mentioned as far back as 1860 where a small lake within 100 miles of Houston is described as filled with bitumen and having in its center a spring which discharged during the summer months an oily liquid, presumably petroleum.

NACHOGDOCHES.

Oil in Texas seems to have been discovered by two hunters in 1867 while on a hunting expedition at a point about 15 miles southeast of Nachogdoches. Subsequently a well was drilled about one mile west of Melrose near the point of discovery referred to. A small quantity of oil was found in the first well drilled, but none in the second well, which was abandoned after having been sunk 80′. Later an eight-inch well was drilled and oil was struck at 70′. The first day the well flowed from 250 to 300 barrels and then ceased flowing. The company continued to drill wells until 1889, and from 1887 to 1890, ninety wells were drilled in Nachogdoches county. In 1890 there were 30 wells in this county, but the oil was found unsuited for the manufacture of illuminating oils. It was of a brownish red color with a peculiar odor not offensive to the degree that Pennsylvania oil is. It remained mobile at a temperature below zero Fahrenheit, and at no temperature obtainable in the laboratory at hand could solid paraffin be separated. A fractional distillation was made of this oil in a retort and the result is shown in the *appendix*. At the present time the Nachogdoches field has known considerable activity, but with no marked results in the increase of the production of oil.

In the state of Texas there are oil indications in thirty-six counties. Oil wells are in operation in eight counties, and gas has been discovered in thirty-one counties in the state.

The oil of the Gulf Coastal Plain, which plain covers all the oil wells of southeast Texas, is probably derived in part at least from the action of decomposing matter, animal or vegetable, or both.

Mr. Robt. T. Hill offers this hypothesis for the Texas and Louisiana oil fields: "The oil and salt pools of Texas and Louisiana are not indigenous to the strata in which they are found, but are the resultant products of columns of hot saline water which have accumulated, under hydrostatic pressure, at points along lines of structural weakness, through thousands of feet of shale, sand and marine littoral sediments of the coastal plain through which oil and gas are disseminated in more or less minute quantities. The oil and sulphur may have floated upward on these waters, and the salt and dolomite may have been crystallized from the saturated solution."

NOTE—For a complete discussion of the geology of this section, I would refer you to bulletin No. 22, of U. S. Geological Survey, also to bulletin No. 1, of University of Texas Mineral Survey.

CORSICANA.

Oil was discovered at Corsicana, sometime prior to 1894, by Major Alex. Beaton, in sinking an artesian well for a water supply for the inhabitants, and at 1,027 feet struck a vein of oil. This oil was cased off and the boring continued to 2,470 feet when a good flow of warm water was reached. The oil, however, soon made its appearance through the soil, on the outside of the casing, and has flowed more or less ever since. With this evidence of oil, a company was formed and wells sunk. The wells vary in depth from 1,000 to 1,040 feet, to the top of the oil bearing sand, and the sand is from ten to forty feet thick. The oil rock is very regular and dips to the southeast about 1 foot to the 100 feet. After oil is struck it is usually about 24 hours before it reaches the surface. The oil is forced up by gas, and sometimes it throws the oil 100 feet clear of the ground.

In January, 1898, there were 65 flowing wells, and six dry holes had been dug—a fraction less than 10 per cent. The total production of these wells was about 900 barrels per day. The known field at this time was about 2½ miles by three-fourths of a mile, and it lays northeast and southwest, about 20° to 22°.

The elevation of Corsicana is 427 feet above the sea, therefore, the oil bearing strata is something like 600 feet below sea level. The drilling is entirely through Ponderoso marl, and the oil bearing rock is a soft gray shale, and can hardly be called a sand.

The Corsicana field produces two grades of oil; a light and a heavy oil. The light oil is suitable for distillation and the production of commercial burning oils and gasoline and is worth on the market nearly double the heavy oil production from the same field.

As a gas oil the lighter grade gives very satisfactory results, and yields from 5.50 to 5.75 candles per gallon of oil used, and as high as 32 candle power gas has been made.

Two extensive plants for the utilization of this oil have been in operation for several years in the vicinity of this field.

From the time of the discovery of oil at Nachogdoches up to the opening of the Corsicana field many wells were drilled for water or oil throughout the state, and many wells are reported as having small traces of oil.

BEAUMONT.

In 1892 a company was formed for the purpose of drilling for oil, gas or anything else, in South Texas and a well was sunk to a depth of 300 feet near Gladys City and but a short distance from the point where the now famous Lucas gusher was brought in. This company was organized by Mr. Patilo Higgins, who was later identified with the Higgins Oil and Fuel Company, a going concern in Texas to-day, and the failure of the first well near Gladys City is attributed to the lack of knowledge in drilling. Mr. A. F. Lucas, who had extended experience in boring wells in the salt district of Louisiana, began drilling on the famous Spindle Top the latter part of 1900 and at a depth of 1,130 feet brought in the famous Lucas gusher on January 10th, 1901. The oil came up with terrific force, and rose to something like 300 feet above the ground. Its violence was such that it carried with it 12,000 pounds of four inch pipe and practically wrecked the heavy derrick and tackle, showering rocks and sand with its first flow. The well is estimated to have yielded about 250 barrels per hour from the start, and rapidly increased until it was estimated that 75,000 barrels per day were coming to the surface. After flowing for nine days the well was successfully capped. It would require the skill of the greatest writers of the day to describe the excitement that immediately followed the development of the Lucas well. Thousands of people rushed to

Beaumont, Gladys City and Port Arthur and taxed the accommodations of all these places beyond their capacity. Buildings were hurriedly erected and a mushroom city appeared to be followed by the substantial buildings which to-day testify to the prosperity of the Spindle Top yield. Gusher after gusher followed and many dry holes were bored. At one time it was estimated that the Beaumont district was yielding no less than 500,000 barrels of oil per day, which production was in excess of the entire yield of oil of the world.

Spindle Top heights is a low ridge of land about thirty feet above the level of the surrounding prairie at its highest point and is approximately one mile wide and two miles long. Its greatest dimension bearing about northeast, southwest. The Lucas gusher is located near the south end of this ridge. It is regarded by geologists as probable that this rise of ground is due to the flexure of the strata forming the earth's crust, but it is possible that erosion may have been instrumental in the shaping of its topography.

With the enormous production of oil the result of the rapid development of the Texas field, the large investments that were necessary to take care of this immense product required time for organization and construction of plants for its storing and utilization. The fuel consumption began about the first, and millions of barrels of oil have been used under boilers. In the appendix will be found a statement of the heating value of these oils.

The Southern Pacific Railway which passes through Beaumont was one of the first to utilize this oil for boiler purposes and the practice has become so general that the train men now distinguish an oil burning locomotive from a coal burner as a "breech loader or a muzzle loader."

SOUR LAKE.

A well was sunk in 1885 at Sour Lake, since quite a noted oil field. This well gave a heavy lubricating oil 16° Baume. This well at Sour Lake later on prompted a wild rush for this territory after the Spindle Top developments.

In June, 1901 the Guffy Company began drilling at Sour Lake and at 900 feet struck a gas pocket. Later in 1903 the Sour Lake district was developed and nearly nine million barrels of oil were produced in that year.

SARATOGA AND BATSON.

Saratoga and Batson districts are in close proximity to Sour Lake as will be seen on the accompanying map, and developed almost simultaneously with Sour Lake.

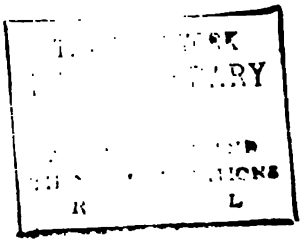
HUMBLE.

This field has been much in the eye of the oil world for the past few months. Much was predicted for it and on January 7th last, the first true gusher was brought in and started off at the rate of 8,500 barrels per day.

The oil from this well is very dark and approximately 22° gravity. It shows enough paraffin, upon test, to justify calling it a paraffin base oil as distinguished from the asphaltic base product in the other southeast Texas fields. The Humble field was the victim of an in-rush of salt water early in March and the production dropped from 93,000 barrels per day to 25,000. This condition, however, gradually improved after a few days. This experience of salt water had the effect of raising the price of oil just as the appearance of a gusher tends to lower the price.

Oil stored at Humble April 30th, 1905, was 2,750,000 barrels.

The experience of the several gas companies with gas oil distillate from Texas oil for water gas production would seem to indicate that this oil "runs about 28° Baume, although 24° and 27° oil has been used. One plant has used it for three years and says that the distillation tests show that 3% distills under 350° F., while 5% remains at a temperature of 630° F., the distillate contains less than 0.5% sulphur. The working results have been entirely satisfactory, although the gas requires slightly more careful treatment in cold weather. A report from another works say that after a year's use the Texas Solar Oil has been found to give good results, is uniform in quality, clean and with little odor. They state that it may require but from 5 to 7 per cent. more oil to obtain the same candle power as when using the best Pennsylvania product. Another large company has been using this oil for two years, has never had any trouble with it, and declares that it is very satisfactory. Its gas making efficiency is very slightly less than Pennsylvania oil and somewhat more tar is produced, but they find it pays to use it. Another company says the oil is uniformly good quality.



The Beaumont crude oil has been used at the New Orleans plant for several years past and the result of one month's average is:

Candle power 23.60
Candles per gallon of oil used 5.74

About one-half of the gas in New Orleans is sent out under high pressure, that is, from 25 to 30 pounds. An examination of candle power of the compressed gas shows hardly any appreciable reduction which might not be accounted for in various ways, and similar results were obtained as to heating value as shown by the junker calorimeter.

The following statistics show the actual number of producing wells in each of the fields; as of February 1st, 1905, the gross daily production and the average daily production per week:

Field	Gross reduction	No. of wells	Av. bbls. per well.
Batson	11,000	256	43—
Sour Lake	11,450	103	111+
Saratoga	20,135	38	530—
Spindle Top	5,730	100	57+
Humble	9,310	4	2,327+

There are eight companies engaged in the business of piping oil in the Southeast Texas fields, representing 513½ miles of pipe line—4inch and above. The mileage represented by each company follows:—

SUMMARY OF PIPE LINE MILEAGE; PUBLIC SERVICE COMPANIES.

The Texas Company ..... 126 miles
The Sun Company ..... 38½ miles
Total (32 per cent. of all) ..... 164½ miles

PRIVATE PURPOSE COMPANIES.

J. M. Guffy Petroleum Company ..... 135 miles
National Oil and Pipe Line Company ..... 18 miles
United Oil and Refining Company ..... 30 miles
Higgins Oil and Fuel Company ..... 22 miles
Security Oil Company ..... 126 miles
Raywood Rice Company ..... 18 miles

Total (68 per cent of all) ..... 349 miles
Total mileage in all ..... 513½ miles

The storage charges in the Southeast Texas field is 33⅓ cents per day per 1000 barrels, or one cent per barrel per month.

Pipe line charges vary according to point from which oil comes and to which it goes from 3 cents to 15 cents per barrel.

There is a dockage charge at Port Arthur of 1 cent per barrel for the first 5000 barrels, and one-half cent per barrel for all over that at one loading.

(From Oil Investors' Journal, February 18, '05.)

"PIPE LINE RATE FROM HUMBLE TO PORT ARTHUR 27 CENTS."

"The J. M. Guffey Petroleum Company on February 14th, announced that the charge for piping oil from Humble to Spindle Top would be 25 cents a barrel, and from Humble to Port Arthur 27 cents a barrel. The six inch pipe line, from Humble to the Trinity river, laid by the Texas company, is 26.5 miles in length. The Guffy line from the Trinity river to Sour Lake is 25.8 miles long, and the line from Sour Lake to Spindle Top (Lucas Station) is 22.9 miles long, making the total length of line from Humble to Spindle Top 75.2 miles. The distance from Spindle Top to the docks at Port Arthur is 14.1 miles, therefore the charge of 27 cents from Humble to Port Arthur covers a distance of 89.3 miles, and is at the rate of less than one-third of a cent a mile per barrel. Arrangements are under way for a test of the Humble-Sour Lake line, which has just been completed. It will be in operation within a very few days."

A large number of earth storage tanks have been built in these suddenly developed gusher fields. A shallow depth of water is placed in them and the oil is then floated on top of the water. This prevents the loss of oil by seapage into the earth bottom, the only portion of oil coming in contact with the earth being at the sides of the tanks. This water stratum is maintained by rains or pumping in fresh supply when necessary.

Some idea of the growth of the production of oil in Texas for the past ten years can be obtained from the following table:

ENTIRE PRODUCTION OF OIL IN EACH FIELD, IN BARRELS.

Year	Corsicana	Spindle Top	Sour Lake	Saratoga	Batson	Grand total
1895	50	.....	.....	.....	.....	50
1896*	1,450	.....	.....	.....	.....	1,450
1897	65,975	.....	.....	.....	.....	65,975
1898	544,620	.....	.....	.....	.....	544,620
1899	668,483	.....	.....	.....	.....	668,483
1900	829,560	.....	.....	.....	.....	829,560
1901*	763,424	3,593,113	.....	.....	.....	4,356,537
1902	571,059	17,420,949	.....	.....	.....	17,992,008
1903	401,817	8,600,905	8,848,159	75,000	4,518	17,530,339
1904	503,647	2,828,150	5,707,500	704,350	10,204,300	19,947,947
	4,350,085	32,443,117	14,555,679	779,350	10,208,818	62,337,969

*1896—Corsicana field opened up.

*1901—Spindle Top opened up January 10th of this year.

RANK OF TEXAS AS AN OIL PRODUCING STATE FOR THE PAST TEN YEARS.

1895	12th
1896	8th
1897	9th
1898	7th
1899	7th
1900	7th
1901	6th
1902	2nd
1903	3rd
1904	3rd

In the older fields of the north the formation is wholly different from that of Texas and the southwest. In the north a well that will start with a production of 100 barrels per day is the rare exception, but such wells continue to produce oil in paying quantities for years. In many of the fields the producing life of such wells is as much as ten years, and they have been known to produce for more than twenty years. In the southeast Texas fields, wells that start at 10,000 barrels per day or more are common. On the other hand the life of such wells is usually short. The gusher conditions seldom continue longer than three to six months, and only a small percentage of the wells drilled can be operated profitably as pumpers, and judging by experience so far, the life of such a pool would end in three years, and may end in six to twelve months, producing during its life several million barrels of oil.

The following estimate of Mr. J. S. Cullinan shows the investment of the oil industry of Texas; covering the period from January 1st, 1901, to December 31st, 1904:

Drilling 5,000 wells	$ 9,091,500
Equiping wells	1,849,000
Construction of pipe lines	2,743,000
Construction of 10,015,000 barrels of steel tankage	2,503,750
Construction of 10,193,000 barrels of open ground storage	1,325,090
Construction of 7,232,000 barrels of covered ground storage	1,224,540
Construction of 650,500 barrels of wooden tankage	260,200
Investment in refineries	8,750,000
2,000 tank cars, at an average of $1,200 each	2,400,000
50 steamers and barges, used in oil trade exclusively	6,000,000
Total	$36,147,080

By way of illustration of the great benefits Texas has gained by the development of the oil industry, the following comparative statements of production of coal and oil—world's—the United States and Texas, 1903—serve admirably:

COAL.

World's coal production (short tons)	967,858,406
Coal produced in the United States (short tons)	357,356,416
Coal produced in the State of Texas (short tons)	926,759

Amount produced by the United States equaled 37 per cent. of the world's coal production. Amount produced by Texas equaled 3 per cent. of the total production of the United States. In the production of coal Texas ranks twenty-third in the United States. Value of coal produced by the State of Texas $1,505,383.

OIL.

World's oil production (barrels)	195,203,511
Oil produced in the United States	100,461,337
Oil produced in the State of Texas	17,955,572

Amount produced by the United States equaled 61.46 per cent. of the world's oil production, Amount produced by Texas equalled 17.87 per cent. of the total production of the United States. In production of oil Texas ranks third in the United States. Value of oil produced in the State of Texas, $7,517,479.

In connection with the Texas oil fields it will be impossible at this date to fail to mention the Louisiana oil fields at Jennings and Welsh. The Jennings field is credited with the production of 6,609,000 in 1904, while in 1903, 918,000 barrels were produced and in 1902, 548,000 barrels were credited to the Jennings field, and for the year 1904, Louisiana as a petroleum producing state stands seventh on the list. Jennings oil is lower in sulphur than Beaumont, and is not as well adapted to manufacture of commercial distillates. It is excellent as a crude oil for gas making, and results obtained are fully equal to those from Beumont oils, with less work for the purifiers. Indications are that the gas produced from this oil is more stable than that from Beaumont and Sour Lake.

The results from this crude oil for gas making shows on a month's average:

Candle power	23.84
Candles per gallon of oil used	6.11

The oil bearing sand in this district is an unconsolidated coarse grain sand, lying at a depth varying from 1,800 to 2,200 feet. More or less gas companies use these wells, but there is no such pressure as is found at Spindle Top.

At this time pipe lines are being laid to navigable water, when cargoes can be floated to tide water, the only facilities for shipment from Jennings at this time being the Southern Pacific railroad.

The result of the great excitement which followed the rush to the oil fields of Texas, and the formation of oil companies by the hundreds for the development of oil wells, and in many instances for the gathering in of the dollars of the masses, is very graphically illustrated in the "Answer to Inquiries" column of the Oil Investors' Journal, a Beaumont publication:

The.....Oil Company—In the morgue.
The.....Oil Company—Owns an interest in some Batson production; also interested in a wild cat well drilling seven miles from Walsh, La.; making expenses, has a small sum in bank, and owes nothing.
The.....Oil Company—Occupies a large block of ice in the morgue.
The.....Oil & Gold Company—There's nothing in a name. Also in the morgue.
The.....Oil Company—Same place.
The.....Oil Company—Morgue.
The.....Oil Company—Not operating.
The.....Oil Company—Not operating.
The.....Oil Company—Not operating.
Ad libitum.

And perhaps in many instances, if the truth were known, they have gotten beyond the point where ice could preserve them.

NOTE—I desire to acknowledge my indebtedness for assistance and information in compiling the foregoing paper to J. S. Cullinan, J. M. Guffy Petroleum Co., Higgins Oil and Fuel Co., Oil Investors' Journal, Progressive Age, Texas State University Bulletin.

APPENDIX.

ANALYSIS OF NACOGDOCHES OIL.

	Per cent. by weight.
Below 300° F	0.04
300° to 345° F	0.37
345° to 390° F	1.38
390° to 435° F	2.09
435° to 480° F	3.14
480° to 525° F	6.25
525° to 615° F	7.07
615° to 680° F	5.63
Remaining in the retort	74.03

ANALYSIS OF OIL FROM NEAR WACO, MCCLENNAN COUNTY.

Specific gravity at 78° F 0.836

Fractions by distillation:

Below 250° F ..... 1.14 per cent.
Between 250° and 400° ..... 1.25 per cent.
Between 400° and 500° ..... 11.67 per cent.
Between 500° and 520° ..... 28.36 per cent.

Total below 520° ..... 41.42 per cent.

CORSICANA OIL.

From a well near center of the field, fractional distillation made by Mr. E. H. Ernshaw, chemist for the U. G. I. Company. Oil very dark brown and opaque, but thin and fluid at 60° F.

Specific gravity at 60° F.=39¼°B.=0.8292.

Temperature Deg. F.	Per Cent by Vol.	Per Cent by Wt.	Degrees Baume	Sp. Gr. at 60 Deg. F.	Color, Etc.
A-130 to 200	2.80	2.24	80.0	0.6653	Colorless
B-200 to 250	5.10	4.31	69.5	0.7017	"
C-250 to 300	7.60	6.69	61.75	0.7302	"
D-300 to 350	8.20	7.44	56.00	0.7527	"
E-350 to 400	9.40	8.75	51.25	0 7718	"
F-400 to 450	7.40	7.07	46.75	0.7920	"
G-450 to 500	8.30	8.09	43.00	0.8088	"
H-500 to 550	6.45	6.43	39.50	0.8260	Very faint yellow.
L-550 to 600	7.75	7.85	36.50	0.8404	" "
J-600 to 650	14.95	15.43	33.50	0.8555	Yellow
K-650 to 665	17.25	18 07	31.00	0.8687	Deep reddish yellow
L-over 650	1.30	1.41	26.00	0.8972	Deep red-solid
M-over 650	1.40	1.63	14.50	0.9699	Dark red brown-solid
Residue	.....	2.63	.....	.....	.....
Total	97.90	98 04	.....	.....	.....

BEAUMONT CRUDE OIL RECEIVED JULY 10, 1901.

Color, dark green. Specific gravity .9196=22.2°B.
Fluidity thick.

Fraction No.	Tem. of Dis.	Per Cent by Volume	Per Cent by Weight	Sp. Grav. Direct Baume		Des. of Fraction	Resume
1	200 deg. F.	Water / Oil	Water / Oil				Water 212 deg. F. ..... per cent
2	180–250	Oil 2.4	Oil 2.92	.7760	50.4	Light canary	Naphthas
3	250–300	1.3	1.01	.7967	45.7		180 deg-302 deg. F.
4	300–350	2.3	2.08	.8340	37.0	to	37 per cent
5	350–400	2.4	3.15	.8335	34.0		Burning oil
6	400–450	6.8	6.36	.8654	31.8	Canary	302 deg.-572 deg. F.
7	450–500	15.1	14.45	.8804	29.0	Light brown	56.7 per cent
8	500–550	17.5	17.10	.8991	25.7	to	
9	550–600	23.2	22.87	.9068	24.4		Asphalt oils
10	600–650	17.3	16.84	.8955	26.3	Dark brown	572 deg.-810 deg. F.
11	650–700	2.8	2.87	.9434	18.4		34.6 per cent
12	700–810	2.9	3.21	.0193	2.7	Deep brown	Coke
Coke	.....	.....	3.24	.....	.....	.....	By. Wt. 3.24 per ct.
Total	.....	94.10	96.10	.....	.....	.....	.....

BEAUMONT OIL RECEIVED AUGUST 19, 1902.

Color, dark red. Specific gravity .9336-20.0°B.
Water trace.

Fraction No.	Tem. of Dis.	Per Ct. by Volume	Per Ct. by Weight	Sp. Gravity Direct Baume		Des. of Fraction	Resume
1	200 deg. F	Water / Oil	Water / Oil				Water 212 deg. F. / Trace %
2	200–250	Water / Oil .6	Water / Oil				Naphthas / 200-302 deg. F.
3	250–300	.9	1.79	.8385	37.0	Apple green	15%
4	300–350	.5					
5	350–400	2.6	2.37	8533	34.1	Canary	Burning oil
6	400–450	5.7	5.30	.8681	31.1		302 deg.-572 deg. F.
7	450–500	7.9	7.45	.8803	29.0	Chrome yel	39.7%
8	500–550	12.9	12.32	.8912	27.1	Spruce	
9	550–600	20.2	19.55	.9039	24.9		Paraffin oils
10	600–650	33.4	32.44	.9067	24.4	Terra Cotta	572 deg.-730 deg. F.
11	650–700	8.8	8.79	.9325	21.0	Bronze gr'n	56.3%
12	700-730	4.0	4.06	.9473	17.8	Dk. " "	Coke
Coke	.....	.....	4.02	.....	.....	.....	By. Wt. 4.02%
Total	.....	97.5	98.09	.....	.....	.....	....

ANALYSIS OF PETROLEUM FROM SOUR LAKE, HARDIN COUNTY, TEXAS.

Fraction	Temperature Degrees Fahr.	Per Cent by Volume	Specific Gravity	Color, etc.
1	.....	.....	.....	
2	212–266	0.07	.....	Yellow
3	266–320	0.03	.....	Yellow
4	320–392	1.59	0.684	Yellow
5	392–572	19.49	0.840	Yellow; blue fluorescence
6	.....	.....	.....	
7	572–641	5.15	0.782	Dark yellow
Residue	.....	71.11	0.978	Black
Total	.....	97.44	.....	.....

ANALYSIS OF A GAS OIL.

Made from Beaumont crude oil.
Ordered by New Orleans Lighting Co.
Description, clear, free from suspended matter.

Color, dark brownish black	Sp. Gravity	.8914-27.0° B.
Water by volume	Flash point	179.6° F.
Sulphur by weight 2.1%	Burning point	212° F.

Fraction	Temperature Distillation	Per Cent Volum.	Per Cent Weight	Sp. Dir.	Gravity Baume	Des.	Resume
1	—200 deg. F.						Naphthas
2	200–250						—302 deg. F.
3	250–302	TRACE					Trace
4	302–350	2.6	2.32			thin	Burning oils
5	350–400	3.7	3.35	.8161	43.9	light	302-572 deg. F.
6	400–450	8.5	8.04	.8452	36.7	straw	% by wt. 56.39
7	450–500	15.5	15.08	.8676	31.3	medium	% by vol. 57.68
8	500–550	16.63	16.39	.8871	27.8	amber	
9	550–572	10.75	11.21	.8915	27.0		
10	572–600	3.38	3.63	.9015	25.25	med. amber	Paraffin oils
11	600–650	10.5	10.76	.9126	23.5	dark amber	572-700 deg. F.
12	650–700	26.1	26.82	.9209	22.0		% by wt. 41.21
13	700–		3.06	semi	solid	black lustro	% by vol. 39.98
		97.66	100.66				us coke
							% by wt. 3.06

LOG OF THE LUCAS WELL.

The first one to strike oil in depth, near Beaumont, Texas, begun October 27, 1900; completed January 10, 1901. Time seventy-five days.

From	To	Made Feet.	Formation.
0	36	36	Yellow clay.
36	56	20	Coarse gray sand.
56	170	114	Blue clay pretty hard.
170	245	75	Fine gray sand.
245	265	20	Variously colored gravel, from bean to goose egg size.
265	317	52	Coarse gray sand.
317	352	35	Blue clay.
352	376	24	Coarse gray sand with pyrite concretions.
376	395	19	Blue clay.
395	440	45	Fine gray sand with lignite.
440	448	8	Marl.
448	508.75	60	Gray sand with concretions and much lignite.
508	528.25	0.75	Soft limestone.
508.75	528.25	19.50	Gray clay and sulphurated hydrogen gas.
528.25	529	0.75	Hard sand stone, with calcite depositions.
529	563	34	Gray sand.
563	588	25	Compact hard sand, with pyrite.
588	588.5	0.5	Hard sandstone and calcareous concretions.
588.6	601.75	13.25	Gray clay.
601.9	602	1.25	Hard sand.
602	659	57	Gray clay with calcareous concretions.
659	665	6	White, calcareous shells
665	679	14	Gray clay.
679	685	6	Gray sandstone with oil.
685	692	7	Gray clay with calcareous secretions.
692	715	23	Gray clay, getting harder.
715	717	2	Calcareous concretions with calcite.
717	833	116	Hard gray clay with calcareous concretions much fine pyrite.
833	853	20	Hard gray clay with calcareous concretions much fine pyrite.
853	873	20	Sand stone and pyrite; hard.
873	875	2	Hard rock, apparently limestone.
875	899	24	Fine oil sand, with large layer toward bottom and heavy pressure under it, filling casing for 100 feet above point of drill.
899	979	80	Hard clay.
979	1029	50	Calcareous concretions, with layer of hard sand stone.
1029	1069	40	Struck heavy gas pressure and oil which lasted about one hour and then subsided.
1069	1139	70	Sand mixed with calcareous concretions and fossils.

EVAPORATION TEST MADE WITH BEAUMONT CRUDE OIL AT PLANT OF HOUSTON ELECTRIC STREET RY. CO., TUESDAY, MAY 7th, 1901.

E. H. McGREGOR, President Company.

Duration of test ..... 7 A. M. to 7 P. M.
Oil consumed ..... 1253.14 gallons.
Weight of oil per gallon ..... 7.43 pounds.
Weight of oil consumed ..... 9310.83 pounds.
Water evaporated ..... 106,640.00 pounds.
Water per pound of oil ..... 11.43 pounds.
Temperature of feed water ..... 78° F.
Steam pressure ..... 140 pounds.
Factor of evaporation ..... 1.1866.
Evaporation from and at 212° ..... 13.58 pounds.
Test made under two B. & W. Boilers.

Test made with mine-run Huntington, Ark., coal at the Dallas Electric Company's plant on August 5, under boiler of rated capacity of 370 horse power, based on ten square feet of heating surface, duration of test eight hours from 8:30 A.M. to 3:30 P.M.

Coal consumed 10,000 pounds.
Cost of coal per ton of 2,000 pounds delivered in plant $3.15.
Water evaporated 75,973 pounds.
Water evaporated per pound of coal 7.59 pounds.
Temperature of feed water 90 degrees.
Evaporated from and at 212 per cent 8.87 pounds.
Steam pressure 110 pounds.
Factor of evaporation 1,169.
Cost of coal to evaporate 75,973 pounds of water $15.75.

Evaporation test of Beaumont crude oil at the Dallas Electric Company's plant, under boiler of rated capacity of 370 horse power, based on ten square feet heating surface, using one burner, duration of test eight hours, from 10:25 A.M. to 6.25 P.M. August 17th.

Oil consumed 6447.5 pounds.
Weight of oil per gallon 7 43.
Water evaporated 75,985 pounds.
Water evaporated per pound of oil 11.78.
Temperature of feed water 90 degrees.
Steam pressure 110 pounds.
Factor of evaporation 1.169.
Evaporated from and at 212 per cent. 13.77.
Cost of oil to evaporate 75,985 pounds of water at 59 cents per barrel of 42 gallons $12.19.

The tests were made under the supervision of A. K. Bonta, the engineer, who has charge of remodeling the plant of the Dallas Electric Company.

B. T. U. OF VARIOUS OILS.

	Beaumont	Penn. and Ohio	Baku, Russia
By Redwood	19388	.....	.....
By Prof. Denton	19060	20200	19500

COMPARATIVE TEST OF BEAUMONT OIL AND COAL AS FUEL ON THE SOUTHERN PACIFIC RAILROAD.

Specific gravity of oil used, .9594 (16°B); flash point, 240°F; fire test, 290°F.

	Oil.	Coal.
Miles run	224	224
Average steam pressure	133	130
Gallons water evaporated	6609	5980
Oil burned	755	....
Pounds fuel	6040	8043
Miles per ton	74.14	55.72

Amount fuel doing same work 3.1 bbl. (bbl. 42 gal.) 1 ton.

From this, with oil at 30 cents per barrel, coal should be 93 per ton, or with coal at $3.00, oil should be 97 cents per barrel.

JENNINGS OIL ANALYSIS.

Color, reddish brown. Specific gravity .9172-22.6°B.
Water, 5.00 per cent by volume.
Sulphur, 0.36 per cent by weight.

DISTILLATION TEST.

Fraction No.	Tem. of Dis.	Per Ct. by Vol.	Per Ct. by Wt.	Specific Gravity Direct	Baume	Des. of Fraction	Resume
1	200 deg F.						Water
2	200–250						Naphthas
3	210–302	2.2	2.04	.8517	24 5	Light canary	210-302 deg. F. 2.2 per cent.
4	302–350	0.5	.46	.8568	33.4	Colorless	
5	350–400	0.7	.65	.8618	32.4	to	Burning oil
6	400–450	9.7	9.23	.8726	30.4	Light canary	302 deg.-572 deg. F. 44 7 per cent.
7	450–500	14.1	13.60	.8846	28.3		
8	500–550	13.9	13.53	.8928	26.8	to	
9	550–572	5.8	5.73	.9061	24.5	Canary	Paraffin oil
10	572–600	5.1	5.06	.9102	23.8		572 deg.-760 deg. F. 50.0 per cent.
11	600–650	23.6	22.91	.8903	27.2	to	
12	650–700	17.1	16.93	.9802	24.1	Terra Cotta	
13	700–760	4.2	4.59	1.0041	0.6	Dk. bronze green	Coke
Coke			2.38				By. Wt. 2.38 per ct.
Total		96.9	97.11				

C. C. TUTWILER, Chemist.

JOINT DISCUSSION ON THE MITCHELL AND MILLER PAPERS.

THE PRESIDENT—Gentlemen, I would like to have the discussion on these two papers free and unlimited. Who will start it?

MR. WHEELER—Mr. Mitchell says that 4.27 gallons of oil are required to produce 1,000 cubic feet of gas, with a candle power of 22. I presume he means to enrich. These figures indicate that the efficiency of the oil was 5.1 candles per gallon, which is an indication possibly that the Kansas oil is not quite as good an enricher as the Texas oil, which Mr. Miller says in Beaumont yields 5.74 candles per gallon, or as the Jennings oil, which yields 6.11 candles per gallon.

MR. BAEHR—I might confirm the statements made in the paper by Mr. Mitchell of the difficulty of getting the same candle power results in water gas manufacture with Kansas oil in winter that you get in summer. We have had that difficulty, and I understand that Kansas City has also had a like difficulty. I happened to be at Kansas City about 2 weeks ago, and was told that they are now getting 6½-candle power per gallon of oil used, but in the winter they did not get that much. Our experence in St. Louis confirms that.

THE PRESIDENT—Is Mr. Macbeth, of Kansas City, in the room? We should like to hear from him. Mr. Waring will you say a few words on the subject?

MR. MITCHELL—In reply to Mr. Wheeler, I will say that we are using the distillate. The crude oil will give us unquestionably 5 candles and over per gallon.

THE PRESIDENT—I believe that this classification of oils in candles per gallon is a good deal misleading. It depends largely on the candle power of the gas that you are making. If you make a low candle power gas your candles per gallon are necessarily low. After you reach 18 or 19 candles, every particle of oil that you add increases its efficiency in delivering the candles per gallon. In making a statement of candles per gallon, the candle power of the gas should also be stated. There seems to be no disposition to further discuss this paper. Have you anything further to say, Mr. Miller? If not, a vote of thanks is in order.

On motion of the Secretary a vote of thanks was extended to Messrs. Miller and Mitchell for their interesting papers.

DEFERRED BUSINESS.

THE PRESIDENT—We will now take up the deferred business of yesterday, reading of minutes, etc.

On motion the reading of the minutes was dispensed with, inasmuch as the same had been published in the *American Gas Light Journal.*

MR. BUTTERWORTH—Mr. President, I move that we follow the method of ascertaining who are present at our meetings that is employed by the American Gas Light Association, or some similar method. I have estimated that our total expenses here are about $20 a minute; if it takes 20 minutes to call this roll, the roll call costs us about $400. I move that we adopt the method employed by the American Gas Light Association, which as you know is a system of giving your name at the door as you enter the convention room for the first time.

THE SECRETARY—I second the motion.

THE PRESIDENT—Gentlemen, you have heard the motion, that in the future the roll be called by this Association by the card system, as now in use by the American Association. Nobody, I think, doubts the wisdom of this motion. If there are no further remarks I will put the question. [Put and adopted.]

MR. BUTTERWORTH—I have another motion that I would like to make in this connection. Our numbers are getting quite large. We are a large Association now, and take in about 100 new members at each meeting. It is impossible for us to know each other personally. I, therefore, move that we try, at our next meeting at least, the method for identifying each other that is employed, for instance, by some of the larger electric light associations. The National Electric Light Association has a system by which each person who attends the convention registers on his arrival and is given a serial number. A white button, on which that number is conspicuously printed, is then pinned to the lapel of his coat. The figures are of large size, so that anybody can read them at some little distance. He is given that corresponding number on the register. At the first intermission

between sessions a leaflet or bulletin containing the names of those then present is distributed to all the members, each name having the number which has been assigned to it. Revised lists are distributed later during the meeting containing the names of new arrivals; therefore, throughout the meeting, by referring to to your book you can easily ascertain who any man is whom you may meet, without asking him his name or without seeking an introduction. I move that this method, Mr. President, be tried at the next meeting of our Association, so that we can recognize each other.

THE PRESIDENT—That is also one of Mr. Butterworth's many bright ideas, and I am very glad to put the motion. I would be glad, though, if the motion would be amended to call for a committee of one to take that matter up for the next meeting. If somebody will amend the motion to that effect.

MR. BUTTERWORTH—I will stand for that amendment. Any good way of doing this is satisfactory to me. I don't care what method it is.

THE PRESIDENT—It is better to put a proposition of that kind up to one man to attend to.

MR. BUTTERWORTH—All right, I move that that be done.

THE PRESIDENT—The motion then is that a committee of one be appointed to provide some means, presumably the same means used by the National Electric Light Association, for the identification of new members of this Association.

MR. BUTTERWORTH—All members.

THE PRESIDENT—Oh, I thought it applied only to new members.

MR. BUTTERWORTH—No, to all of them.

THE PRESIDENT—All members of this Association, then. That includes new members, however, admitted at the meeting?

MR. BUTTERWORTH—Yes, sir.

THE PRESIDENT—You have heard the motion. Are there any remarks? [The motion was adopted.]

The President appointed Mr Butterworth a committee of one to attend to the details.

Vice-President Doty assumed the Chair. He introduced Mr. Fred. B. Wheeler, of Detroit, Mich., who read the following paper on

THE PRACTICAL ENRICHMENT OF LOW CANDLE POWER GAS WITH BENZOL: ITS CONVENIENCE AND ADVANTAGES.

It can safely be asserted that up to quite a recent date but little has been heard in American gas engineering practice of the enrichment of low candle power gas with benzol, although references are occasionally seen in the gas journals to its use in Europe, successfully be it said. It is proposed to show in this paper what benzol is, what the sources of supply are, and what can be done with it in the line of raising low grade coal gas speedily and surely to a desired high candle power which will stay put.

Benzol is the product either of the destructive distillation and refining of gas house and coke oven tars, or of the washing of coke oven gas with absorbing oil and its distillation.

Benzol is the commercial name for the complex light oil produced from either of the above processes, and containing benzene (C_6H_6) as its principal part. In Europe benzol was first produced from gas house tar by means of a double distillation. The first distillation was stopped at 170° C. (338°F.) The product was again distilled, the fraction coming off to 100° C. (212° F.), being called 90 per cent. benzol.

The English distilled benzol consists in general of the following:

TABLE I.

70 per cent.	benzene	Boiling point,		80.5° C.	176° F.
25 "	toluene	"	"	110° C.	230° F.
1 "	xylene.	"	"	137° C.	278° F.
4 "	paraffines, etc.				
100 "					

With specific gravity of 0.880 to 0.882.
Vide Butterfield, pp. 306, 307.

It will be seen from this table of composition that 95 per cent. of the volume boils below 110° C. (230° F.), a boiling point only just above the formation of steam and greatly below the temperature of steam at 100 pounds pressure 164° C. (327° F.). The German tar distilled benzol is almost identical with the above sample.

German coke ovens are a source of considerable benzol production. Annually 8,000,000 gallons of benzol are produced, a large part of which is sold to gas companies for enriching. Now the American coke ovens are distilling their product. The American by-product coke oven companies are giving their attention to the manufacture of benzols of similar quality to the German manufacturers. This product is obtained by washing the gas with an absorbing oil—contained in a washer. The gas flowing into this washer bubbles through the absorbing oil and gives up practically all of the soluble components that are life-giving in the gas to the oil.

The oil circulates from the washer to the still, and in the still is steam distilled, the vapors of the operation upon condensation becoming the benzol of commerce. The commercial benzol thus obtained is in general of the following composition:

TABLE II.

Benzene	76.5
Toluene	15.5
Xylene	4.5
Paraffines	3.5
Specific gravity 0.882	100.0

It will be at once noted from Table II. that 92 per cent. of volume evaporates at 110° C. (230° F.), while the amount of the valuable benzene content exceeds that in the foreign product by 6.5 per cent.—the specific gravity being the same—and this product is the standard coke oven benzol for gas enrichment. This product is transported by rail in drums or tank cars, exactly the same as petroleum.

It is now proposed to show what can be done with benzol in the line of enriching low grade coal gas speedily and surely to a desired high candle power, as permanent as any high candle power can be.

In O'Connor's "Gas Engineer's Pocket Book," pages 387, 388 and 389, 2d Ed., 1901, are 3 pages of notes on German and English experience in the use of various grades of benzol. These notes show wide disparity in the results obtained by different experimenters, and are almost valueless, as they give little information as to the quality, purity or source of manufacture of the benzols used. The notes are for the most part

unsigned, many of them are flatly contradictory to each other, and some mention the use of cold benzol, manifestly an improper method.

Butterfield, head chemist at Beckton, says, p. 149, "Chemistry of Gas Manufacture:" "No experimental data in support of doubts on the high value of benzol as an enriching agent have yet come to the author's notice."

European Experiments.—In a very large number of English gas works, the Clark Maxim process of enriching by carburine, a petroleum spirit miscalled benzol, has been in use. However, this has been mostly discontinued because it has been found to be a non-permanent form of enrichment. Carburine vapor has only about one-fourth the enriching value of benzol vapor at the same temperatures.

In Germany, as stated above, 8,000,000 gallons of benzol are produced from the by-product coke ovens, nearly all of which is used in Continental gas works.

Its Use is on the Increase Everywhere.—Dr. H. Bunte, the great German gas engineer (see *Journal fur Gasbeleuchtung*, Vol. XXXVI., p. 442), (*Journal of Gas Lighting*, Vol. LXII., p. 717), says, benzol vapor has volume for volume, or weight for weight, a far higher enriching power than hexane or other paraffines. Weight for weight he finds benzol secures nearly 2½ times the lighting effect of hexane. He estimates that 1 gallon of benzol will raise 24,500 cubic feet of 16-candle power coal gas, one candle in illuminating power. (*Journal fur Gasbeleuchtung*, Vol. XXXVII., p. 81.) (*Journal of Gas Lighting*, Vol. LXIII., p. 485.) He also says that at 0° C. (32° F.) coal gas will carry 3 per cent. by volume of benzol vapors, making a very rich gas.

American Benzol Enrichment Experiments.—In the spring of 1904 an installation was made at a plant we will call A. In May the output was 21,866,400 cubic feet, or 705,368 cubic feet per day. For the purpose of this experiment, the initial candle power was 13.48, which was brought up to 18.55, a rise of 5.07 candles by the use of 0.207 of a gallon of benzol, or 0.0408 of a gallon per 1,000 cubic feet per candle. To put it in another way, the number of cubic feet raised 1 candle by 1 gallon was 24,491. It will be observed this figure is almost exactly that quoted above from Dr. Bunte. This experiment covered 30 days' time.

The gas was test during this period of an average chemical composition of:

TABLE III.

[illegible]	2.0
[illegible]	.8
[illegible]	3.9
[illegible]	0.3
[illegible]	5.0
[illegible]	33.6
[illegible]	33.0
N	9.4
	100.0

The 3 [illegible] were before enrichment .667 gross.
" after " 675 "

During the tests [illegible] the amounts of oxygen and nitrogen were purposely increased to reduce the heat units and flame temperature. The results are shown in—

TABLE IV.

	Candle Power—Initial	Candle Power—Enriched	Gallons Benzol Used	Gallons Benzol per 1,000 Cubic Feet Gas	Candles Enriched	Cubic feet of Gas 1 Gallon 1 Candle
June 3	13.90	18.27	193.57	.2010	5.27	26,709
" 4	14.02	19.40	112.23	.1370	4.38	31,965
" 5	15.71	18.67	112.23	.1338	2.96	22,102
" 6	13.12	17.70	185.31	.2121	4.58	21,587
" 7	12.80	18.16	171.30	.2024	5.26	26,473
" 8	15.12	18.24	73.95	.0906	3.12	34,414
" 9	15.53	17.74	46.11	.0535	1.91	35,648
" 10	11.14	18.20	301.89	.2793	7.55	20,222
" 11	11.25	18.14	314.07	.3110	5.89	31,407
" 12	13.90	17.76	136.59	.1322	5.86	29,189
" 13	15.06	18.58	148.77	.1486	3.52	23,683
" 14	14.75	17.45	107.88	.1171	2.70	23,045
" 15	13.32	17.85	168.78	.1697	4.53	26,690
" 16	12.94	16.84	194.88	.1927	3.95	20,553

During the test the following results were obtained:

Initial candle power	13.70
Enriched candle power	18.00
Increase in candles	4.30
Cubic feet gas	13,066,800.00
Gallons benzol used	2,267.65
Gallons benzol used per 1,000	0.1725
1 gallon enriched 1 candle	24,783. cu ft.

The average chemical composition of the enriched gas was:

TABLE V.

CO_2	2.0
C_6H_6	.8
C_2H_4	3.3
O_2	1.6
CO	5.3
CH_4	40.0
H_2	35.7
N	11.3
	100.0

Attention is again called to the fact that the oxygen and nitrogen content was purposely increased.

The B. T. U's were before enrichment.....645 gross
" " " after " .....655 "

This gas was pumped through a 10-inch main 1 mile long, and and at the delivery point after purification showed no change in candle power. The above experiments were made in the late spring. The effects of cold remained to be determined.

Ordinary coal gas of 18 candles usually carries at least 1 per cent. of benzene C_6H_6, and has been transmitted through mains with extreme conditions of temperature for many years with no extraordinary loss.

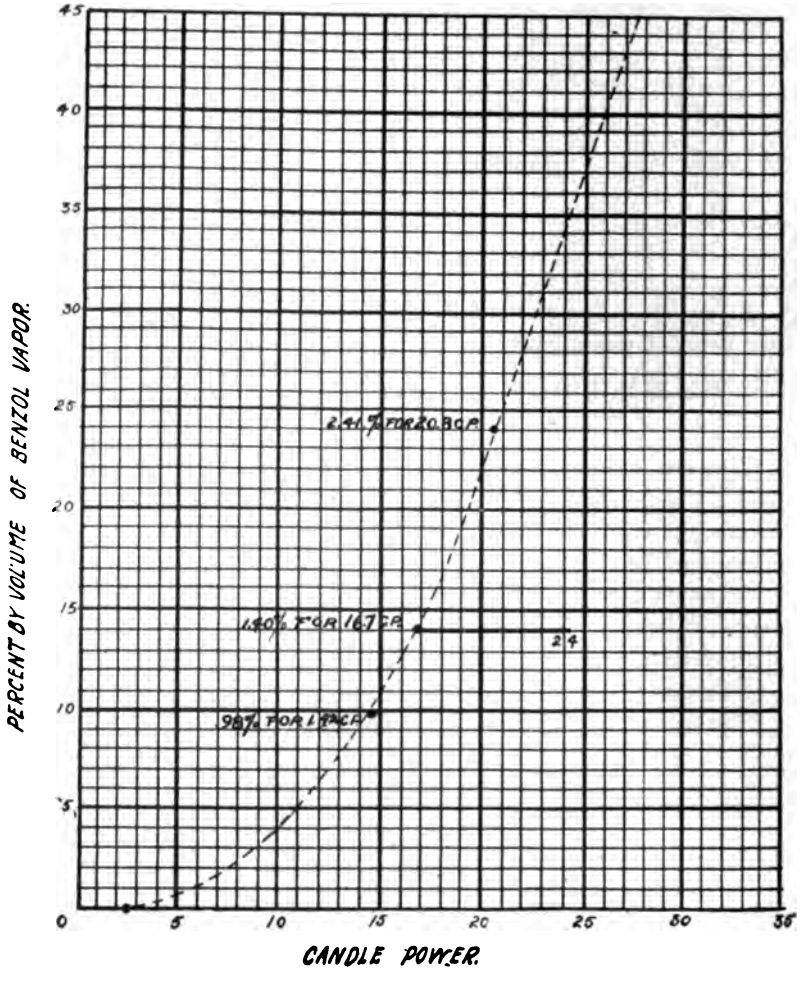
The following table of benzol vapor in coal gas is of interest:

TABLE VI.

Temperature. C.	Temperature. F.	Cu. Ft. C6H6 Vapor contained in 100 Cu. Ft. Gas.
—10	+ 14	1.70
— 5	+ 23	2.41
0	+ 32	3.33
+ 5	+ 41	4.49
+10	+ 50	5.95

In the graphical chart, it is shown that in a coal gas freed from ethylene, at a volume of 1.4 per cent. of benzol there is a 16.7 candle power. Then if the gas had an initial candle power due to ethylene of say 7, there will be obtained a 24 candle gas. The above table VI. shows that at 14° F., 1.7 per cent.

GRAPHICAL CHART SHOWING CANDLE POWER AND BENZOL VAPOR IN COAL GAS FREED FROM ETHYLENE



C_6H_6 can be in coal gas. This is 18° F. below freezing point. It may not be generally known that when the ground is frozen to the bottom of a gas main, the temperature of the interior of the pipe is rarely below 0° C. (32° F.). Hence from the above table we see that the carrying power of coal gas at 32° F., is much above the volume of C_6H_6 usually found in the best coal gas.

Butterfield (p. 149, Ed. 1896) says: "There is ample margin even at 0° C. (32° F.) for the retention in gas of sufficient benzol vapor to give it an illuminating power of 25 candles."

We may confidently expect then to find no more loss or condensation than with unenriched high grade coal gas, or cannel coal gas. It was deemed desirable to confirm the previous test in very cold weather. An opportunity was offered at Plant B. It was decided to test the candle power on the start, and after it had travelled several miles through a very shallow pipe and in zero weather. The output from this particular works was pumped through a 16-inch main more than 2 miles long, laid for at least 1 mile just under the paving stones. Arrangement were made to take the temperature of the gas flowing in the mains, also to read constantly the candle powers at both ends. During the journey of the gas it was under about 2 pounds pressure.

A series of experiments were made to determine absolutely the drop of candle power of the gas *entirely unenriched*, and transmitted under varying conditions. The gas was then enriched by benzol to different candle powers, some as high as 23, and transmitted under like conditions. The temperature of the gas at the station meter varied but slightly from 60° F. The temperature of the gas flowing through the shallow main was 37° F., a 23° F. drop from the station meter. The gas was delivered at a temperature of 42° F. to 47° F. through a section of deep laid cast iron 20-inch main. The outside air temperature varied from—15° F. to 34° F., and the ground was frozen to a depth of 3 feet.

The loss in transmission was determined, then enrichment began under the same conditions as before. The benzol used had the identical composition of that in Table II. The results were as follows:

TABLE VII.—*Consecutive Days.*

Day.	Initial Unenriched.	Enriched.	Raise in Candles.
1	11.87	20.05	8.18
2	13.05	19.64	6.59
3	14.45	20.72	6.27
4	14.98	20.98	6.00
5	14.66	20.77	6.11
6	14.14	20.80	6.66
Average	13.86	20.49	6.63

The average amount of benzol used was 0.3285 gallons for a 6.63 candle rise, or 1 gallon raised 20,000 feet, an average of 1 candle. The temperature of the main remained constant at 37° F. The average loss in candles at the end of the long travel under 2 pounds pressure was 0.28 of a candle.

TABLE VIII.—*Second Period, Consecutive Days.*

Day.	Initial Unenriched.	Enriched.	Raise in Candles.	Benzol Used.
1	13.20	20.59	7.39	.3399
2	13.00	19.92	6.92	.3182
3	13.03	20.38	7.35	.3308
4	13.21	20.47	7.26	.3484
5	14.01	20.35	6.34	.2917
6	16.18	20.89	4.71	.2356
7	16.09	20.90	3.81	.1957
8	15.07	19.26	4.19	.1926
Average	14.22	20.34	6.12	.2516

The average amount of benzol used was 0.2816 gallons. The average candle power raise was 6.12 candles, equal to 0.0460 gallons to raise 1,000 feet 1 candle, or 1 gallon raised 21,739 feet 1 candle. The average loss in transmission was 0.24 candles. The figures here obtained were checked at a third plant having the same length of pipe line and same general conditions. The temperature of the main was exactly the same—37° F. The gas here had an average initial candle power of 8.15; was raised 9.22 candles to 17.37 candles; measured at its 2-mile journey's by 0.384 gallons of benzol, giving thus an enriching value of 24,039 cubic feet, 1 candle from 1 gallon.

Further experiments have since been made to determine the value of benzol for enriching very lean gas, containing as high as

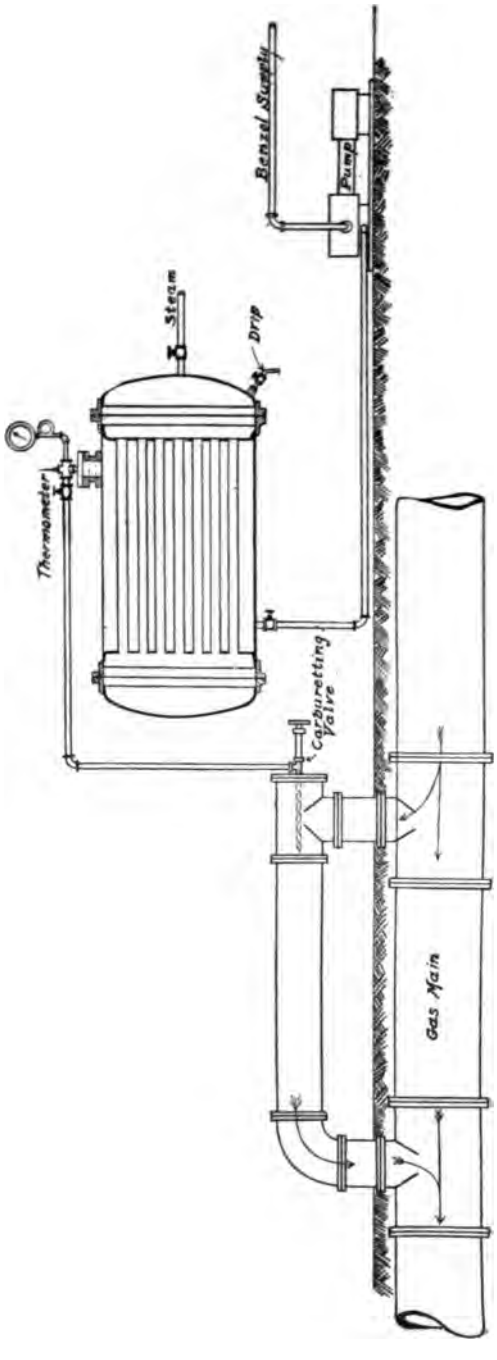
2 per cent. oxygen. For 4 days in Plant B, the average initial was held at 6.94; the average rise was 11.48, and the enriching value with this high per cent. of air was 22,000 cubic feet per gallon.

At a fourth plant the benzol enriched gas was pumped under pressures varying from 7½ to 10 pounds through a 12-inch main 38 miles long. The gas had an average initial candle power of 14, was raised to 18.8-candle power, and after its long journey arrived under pressure at 18.6-candle power, a loss of only 0.20 candles. Later, under somewhat different conditions, the loss was an average of 0 80 candles.

The question of high pressure transmission on the quality of any illuminating gas is important. It will be well to observe that recently Mr. J. D. Shattuck states that for 6 months coal gas was pumped, and for 6 months water gas, under a 25-pound pressure at his works. The loss with coal gas was 0.33 candles, and with water gas was 0.90 candles. Compare these figures with results on benzolized coal gas given above.

The quickness and ready convenience of the method will commend itself to all from the following description: The diagram shows a complete enriching plant. The benzol is fed to the vaporizer from a suitable measuring tank by a small duplex pump. The vaporizer consists of a boiler in which the oil is outside of the steam heated tubes. These tubes have sufficient surface to evaporate in the plant shown, benzol enough to enrich 3,000,000 feet of 6 candle coal gas 12 or 14 candles. The plant shown occupies a ground floor area of scarcely 4 feet by 9 feet. The vaporizer has a vapor pressure of gauge on the top, also a thermometer. With a steam pressure at the plant of 80 to 100 pounds, a vapor pressure of 30 pounds, a temperature of 130° to 440° C. (284° F.) is maintained. The vapor passes through a carburetting needle valve into a small by-pass on the gas main. The gas flow sweeps the vapor along into the gas flowing in the main.

The steam is first turned into the vaporizer, then the benzol pump is started and the needle valve opened when the vapor pressure gauge shows, say, 10 pounds pressure This operation in the vaporizer shown here does not take more than 5 minutes. The vapor pressure is usually carried at a point from 20 to 30 pounds. A steady flow of vapor passes into the gas main as long as the steam pressure is maintained.



Carburetting Plant,

The volume of benzol vaporized, and consequently the amount of enricher fed, are regulated by the needle valve opening, the pump speed and the steam valve opening. The amount of steam used is nominal, as all pipes and the vaporizer are lagged.

The method is speedy, almost instantaneous, in fact, economical to operate, requires no extra labor, and in 5 minutes can raise a 6-candle, blue-air coal gas to 16, 18 or more candles with an amount of oil equivalent to about 0.04 of a gallon per candle per 1,000.

In this country gas companies, especially the smaller ones, have hitherto had their choice of methods of enrichment confined to the use of cannel coal, water gas, or of some form of oil gas generated in their benches.

At present the use of cannel coal enrichment is nearly obsolete, on account of the price of cannel as well as on account of the irregularity and uncertainty of the candle powers obtained, and because of the deterioration of the quality of coke produced when cannel is used. Most small gas companies cannot afford the capital cost of a small water gas installation simply as an enriching adjunct to their plants. The uses of most of the forms of oil gas enrichment are extremely wasteful and expensive. The cost of the enrichment per candle is at many small coal gas plants extremely high, the writer knowing of plants where the cost has been as high as 5 cents per candle. No small gas plant should have an enriching cost higher than 1.25 cents per candle. The method of benzol enrichment outlined above possesses all the elements desired by most small gas plants for speedy, economical enrichment of their coal gas. The rapidity and ease of starting up the apparatus to full working capacity, its small steam consumption, its negligible labor cost, its low interest charge make up a combination that no other enriching system has. It will enable them to take off a very much higher yield per pound and yet reach any reasonable desired candle power. Particular attention is called to this feature permitted by the installation of the benzol method.

The first cost of the benzol enriching plant is small, its space requirement is a corner, its simplicity is so apparent that it must commend itself to all managers requiring a coal gas delivery above 15 candles, whose works are unable to install an expensive enriching plant. For a small coal gas works, the cost per

candle of enrichment is lower by the benzol method than by the use of any other method of enrichment known to the writer.

DISCUSSION.

VICE-PRESIDENT DOTY—You have heard Mr. Wheeler's scientific paper. Mr. Wheeler presents a new method of enrichment to you. Those who know Mr Wheeler know him to be the type of engineer of which Mr. Chollar speaks, not only an engineer by diploma but an engineer who knows how. The subject is open for discussion. Mr. Lathrop, you have had experience with benzol enrichment?

MR. LATHROP—We have had only a little experience, so I am not able to say anything in particular about it. We hope to have more experience in the course of a year.

VICE-PRESIDENT DOTY—Professor Turneaure, would you like to enter into this discussion?

PROF. TURNEAURE—It is a subject for investigation.

VICE-PRESIDENT DOTY—Mr. Forstall?

MR. FORSTALL—Anything that I might say would merely bear upon previous literature, which Mr. Wheeler has already gone over in his paper. I have had no actual experience with benzol enrichment, and personally I am not very strongly in favor of vapor enrichment of any kind. You can get enrichment for nearly the same cost with permanent gas.

VICE-PRESIDENT DOTY—Would you then want to take the position of advocating water gas as an enricher?

MR. FORSTALL—I think it is more permanent.

VICE-PRESIDENT DOTY—I hope, gentlemen, there will be a discussion of a paper of such value as this. If there is to be no discussion, it would be better to my mind to take the paper as read and save the Association's time, the value of which Mr. Butterworth has spoken. The value of these papers to a certain extent lies in the discussion. The officers of the convention can prepare a paper list for you and print it, and you can read at your leisure at your homes, but as I understand the great value of these Association meetings is in the discussion. Mr. Mitchell.

MR. MITCHELL—Mr. President, I believe that the arrangement as shown on the illustration here would be a grand arrangement for those troubled with naphthalene. This will greatly assist in preventing and in dissolving the naphthalene in gas.

MR. ELBERT—In looking over this illustration, it seemed to me that Mr. Wheeler would get better results from the heater if it stood vertically instead of horizontally; that is, he would get greater efficiency out of the heater.

VICE-PRESIDENT DOTY—Mr. Butterworth, have you had experience with benzol enrichment?

MR. BUTTERWORTH—I have not.

VICE-PRESIDENT DOTY--Mr. Miller.

MR. MILLER—I have not anything to say on those lines of enrichment.

VICE-PRESIDENT DOTY—Mr. Slater.

MR. SLATER—Mr. President, in regard to the use of benzol for enrichment, I think the results that have been obtained in Europe very well substantiate the fact that it is a good enricher, and I am very glad Mr. Wheeler reported favorably on it. At the meeting of the New England Association of Gas Engineers, in 1902, I made some remarks touching upon benzol as an enricher and they were very intelligently criticised, but one of the gentlemen implying that it was not of special value as an enricher. I think that the figures Mr. Wheeler has given can be well substantiated; in fact I know by private correspondence with European engineers that they are. Regarding the matter of naphthalene, as stated by Mr. Mitchell, I think that is a point which deserves very careful attention, because it is a valuable point for a gas man. Benzol is one of the best solvents of naphthalene and a good carrier. If proper attention is given to climatic conditions where the benzol is used, very excellent results can be attained, both in regard to candle power and to the satisfaction with the operating condition of the mains as regards naphthalene.

VICE-PRESIDENT DOTY—Mr. Baehr?

MR. BAEHR—I don't think I can say anything about this at present.

VICE-PRESIDENT DOTY—Is there any further discussion? Mr. McDonald.

MR. DONALD MCDONALD—I have had absolutely no experience on this subject. Anybody else here can speak as well as I can. I don't see that I can say anything.

VICE-PRESIDENT DOTY—If there is no further discussion, I will call upon Mr. Wheeler to close the debate.

MR. WHEELER—I realize, gentlemen, that this is a new subject, and I know that very few of you have had experience in its use, but if you could see the readiness with which you can speed up this small machine and make a 20-candle power gas that will stand pumping in any weather, you would appreciate its value. I think that the gas is as permanent under the same temperature and pressure conditions as any gas. I fail to see where there is any difference between benzol gas and any other kind of gas, so far as the transmission goes.

VICE-PRESIDENT DOTY—Is it a fixed gas?

MR. WHEELER—You can mix this gas with coal gas or water gas, and it will carry as well as either of the gases singly. As I say, the gas is being pumped 38 miles, and it carries as well as any water gas or coal gas that any of you are familiar with.

MR. SLATER—The Chairman made a remark some time ago that brought an idea to my mind, one I think could be well carried out. It is this: Our Association very often have papers brought before them that in the time usually available are very difficult to sufficiently digest or discuss properly at the meetings at which they are presented. I know of at least one Association that does make a practice of assigning the subjects for further discussion at the next meeting, even though they meet only annually. The interval seems long, but that I have found has brought good results and has been the means of having the subject thoroughly brought out, and any fallacies in the original paper brought to light and disposed of, and the good points also were brought out more pointedly, and good points that might not be touched on in the paper have also been brought out. I think that such a thing could well be done by our Gas Associations.

VICE-PRESIDENT DOTY—I expect to have something to say on that question this afternoon, Mr. Slater, unless plans fail.

On motion of the Secretary a vote of thanks was tendered to Mr. Wheeler for his very able paper, in which there is so much evidence of thought and research.

VICE-PRESIDENT DOTY—The next order of business is the report of the Committee on President's Address. Mr. E. G. Pratt is the Chairman. Mr. Forstall, you are a member of that committee.

MR. FORSTALL—Mr. Pratt has both copies of that report, and I have not any. In his absence I cannot present the report.

VICE-PRESIDENT DOTY—You ask to be excused, then? The next order of business is

THE REPORT OF COMMITTEE ON PLACE OF NEXT MEETING.

Mr. Barret is Chairman of that committee.

MR. BARRET—Mr. President, Mr. McDonald will present that report.

MR. MCDONALD—Mr. President, the committee would report for the consideration of the Association, Cleveland as the next place of meeting.

VICE-PRESIDENT DOTY—You have heard the report of the committee naming Cleveland for your consideration. What is your pleasure, gentlemen?

MR. MITCHELL—I move the adoption of the report. [Seconded.]

VICE-PRESIDENT DOTY—It is regularly moved and seconded that the report be adopted and Cleveland be selected as the next place of meeting. [The motion was adopted.]

VICE-PRESIDENT DOTY—Report of the Library Committee.

THE SECRETARY—Mr. Thwing has the report.

VICE-PRESIDENT DOTY—The report of the Library Committee is called for, but by reason of the absence of the Chairman it will have to be deferred.

ADDITIONAL REPORT FROM THE MEMBERSHIP COMMITTEE.

VICE-PRESIDENT DOTY—It has been suggested, gentlemen, that we have a further report from the Membership Committee. In view of their activities, there are more new members to be elected. If there is no objection I will call for the report of the Membership Committee. Mr. Wm. McDonald.

MR. MCDONALD—The following additional gentlemen have applied for membership in the Association:

Active.

Abell, W. A., Taylorville, Ill.
Connors, M., Chicago, Ill.
Farr, A. L., Chicago, Ill.
Gross, A. H., Chicago, Ill.
Higgins, H. C., Dixon, Ill.
Miller, R. L., Muncie, Ind.
Richards, F. M., Madison, Wis.
Stratton, C. J., Chicago, Ill.
Scott, E, LaPorte, Ind.
Shumway, J. N. C., Taylorville, Ill.

Associate.

Buel, T. D., Detroit, Mich.
Cruse, A. R., Philadelphia, Pa.
Gregory, G. H., New York City.
Holbdell, Geo. Jr., Philadelphia, Pa.
Pratt, H. Chicago, Ill.
Welcher, C. W., Chicago, Ill.

VICE-PRESIDENT DOTY—You have heard the report of the Membership Committee. What is your pleasure?

MR. MCDONALD—I move that the Secretary be instructed to cast the ballot of the Association for the gentlemen whose names have just been read. [Adopted].

THE SECRETARY—Mr. President, in accordance with the instructions of the members of the Western Gas Association present, I cast the unanimous vote for the names of the persons just read for membership in the Western Gas Association.

VICE-PRESIDENT DOTY—They are declared elected members, and are invited to participate in the proceedings.

A motion to adjourn until 2 P. M. was carried.

VICE-PRESIDENT DOTY—The motion to adjourn for the noon recess having been agreed to I desire to say that as the first business of the afternoon is the report of the Memorial Committee, it is desired to have as full an attendance of the members as may be possible, in order that proper respect may be shown to the members who have passed away.

SECOND DAY—AFTERNOON SESSION.

The Association reassembled at 2:40 P. M., President Thwing in the Chair.

THE PRESIDENT—Is the Committee on President's Address ready to report? We have in the order of business the report of the Library Committee. There seems to be some misunderstanding as to who constitute the Library Committee, and I would request the secretary to report for the Committee.

REPORT OF LIBRARY COMMITTEE.

THE SECRETARY—Mr. President, in accordance with the instruction of the Western Gas Association one year ago, I have on two occasions sent out lists of the volumes contained in the

Library. The number of volumes loaned during the past year was 25. There have not been many acquisitions, and apparently not much interest is taken. I do not know what to suggest that would make the Library more available or more beneficial, except to announce that in the membership list you will see an index of the volumes contained therein, and should any member of the Association desire to borrow a volume he will observe the conditions under which it can be done. I can report no further than to refer you to the volumes contained in the Thompson Memorial Library, and to suggest that if any of you have volumes that you would like to give to the Association we would be glad to receive them.

THE PRESIDENT—Have you got any data at all as to the number of volumes that have been borrowed?

THE SECRETARY—Not with me.

THE PRESIDENT—Can you give the approximate number?

THE SECRETARY—Twenty-five. We have out now 11 volumes.

THE PRESIDENT—It seems that this Library is not being used to the best advantage, or else all members of the Western Associtian must have complete libraries of their own. It ought to be distinctly understood that this Library is for the use of the members of the Western Gas Association, and if you desire the use of any book contained in it all you are obliged to do is to write to the Secretary, who will furnish the volume to you free of cost. It seems to me the Library should be more used than it is.

On motion of Mr. Mitchell the report was received.

REPORT OF COMMITTEE ON PUBLICATION OF PROCEEDINGS.

THE PRESIDENT—The next order of business is the report of the Memorial Committee, but I would prefer to have a larger attendance to listen thereto. We will take up the report of the Committee on Publication of Proceedings. This Committee, of which I am Chairman, would report that, owing to the lack of matter—that is, not sufficient proceedings to justify the issuance of a volume of the "Proceedings"—nothing has been done in the past year, but it is expected that a volume of the Proceedings from 1902 to 1905, inclusive, will be published this year.

On motion the report was received and the Committee was ordered continued.

THE PRESIDENT—Owing to the absence of Mr. W. B. Calkins, of Fairmont, Va., his paper on

COAL SAMPLING AND TESTING,

will be read by title only and then discussion on it will follow.

Mr. Calkins' paper is as follows.

The common rule expressed in most chemical and metallurgical text books in regard to sampling is that small amounts of the original mass shall be taken with such care that a representative sample is secured. But scarcely any information is given in regard to the number or amount of samples it is necessary to take in order to eliminate any possible chance of a slight error in one or more samples. This paper was not written with the idea of laying down any firm or fixed rule for sampling, but with the hope that those interested in establishing some general rule for sampling would take the matter up and determine for themselves the number of samples necessary to take, the amount to be taken and the method of preparation in order to bring the error to within a fixed or assumed basis. If this can be done and the co-operation of the Association secured, some common rule for sampling can be worked out and a fixed basis established, upon which all future tests can be made. The first few paragraphs of Prof. N. W. Lord's "Notes on Metallurgical Analysis" express tersely why it is necessary to exercise such great care in obtaining small impartial samples which shall truly represent the original mass. He says:

"The object sought by the technical analysis is to ascertain the average composition of some particular lot of material—for example, a carload of ore, an ingot of metal or a bin of coal.

"The amount of material treated in the laboratory is of necessity limited to a few grams. The preparation of this small portion so that its analysis shall correctly represent the composition of the mass from which it is taken constitutes the operation of sampling."

In sampling, as in any other kind of investigation, the person doing the work must know thoroughly what it is he wishes to learn, either of the character of the coal, of the quality of the

coal, or of both. For character no sample need be taken, simply a specimen of the particular seam is all that is necessary. It has been found that there exists a remarkable uniformity of coal over large areas.

The character of the coal seems to depend more on geographical position and geological synclinals than it does upon its place in the geological scale. In other words, it is generally the case that all coals in a particular locality, no matter to what geological seam they may belong, are of the same character. A notable exception to this, however, is in the Kanawha field, where the splint, gas and cannel coals occur in close proximity. The character of a coal is indicative of its application in the industrial world. In the identification of a coal the proximate analysis is more important than any other test. The accurate determination of the volatile matter is of the greatest importance, followed closely by moisture.

Ash is of value only as an indication of the normal condition of sample or specimen in hand, but must never be overlooked, as a very high ash will affect the volatile matter to such an extent that the interpretation of the analysis will be very misleading. As an illustration of this point, let us examine the great beds of coal found in the Appalachian carboniferous series. Here we find the widest range or difference in character.

On the eastern extremity of the bituminous field you invariably find coals low in moisture and volatile matter; going westward, the volatile matter starting at about 12 per cent., increases regularly but gradually, with the moisture remaining constant until a maximum of about 40 per cent. volatile matter is reached. Evidently a bituminous coal cannot contain more than this amount of combustible volatile matter. In order to become more volatile, which they do at about the Ohio river, the coal must take on more moisture. This actually occurs, so that from the Ohio westward the volatile matter remains practically constant, while the moisture increases regularly and gradually as we move westward, until the maximum is reached at the western boundary of the coal basin, where it carries 7 to 8 per cent. of moisture.

The knowledge of these facts would indicate to the coal expert the probable location from which such specimens were taken. In determining the quality of coal, the science and knowledge of

sampling play a very important part, for the small laboratory sample given the chemist must be taken and handled so carefully that it can truthfully be said to represent an average of the original mass. Knowing how difficult it is for two chemists, equally careful and skillful and employing the same methods, to obtain check results in proximate coal analysis, even when each man is furnished with part of the same well mixed finished sample, you can readily see how necessary it is that each man in collecting and preparing his own samples uses some method common to both, in number, amount and mode of handling, in order to eliminate as much as possible the error of the sample.

Anyone that has ever attempted to sample a large mass of coal is acquainted with the difficulties met with in obtaining a sample that will truly represent the original body of coal.

A large mass of coal is more or less a mechanical mixture of several compounds or minerals, varying in size and specific gravity; for instance, the slate and bone coal may be in very small pieces intimately mixed with the fine coal or in flat, laminated layers running through the large lumps, or the pyrites may be present as large sulphur balls, or in very small layers or streaks throughout the coal seam. So the taking of a sample which shall contain the same proportion of coal, slate, bone coal and pyrites as does the original mass becomes a very hard matter and the greater the amount of impurities the coal may contain the greater the liability of error in the sample.

There are very few coals that have more than 5 or 6 per cent. of real ash in the normal coal, but admixtures of slate, bone coal, sulphur balls and foreign substances from the roof or floor of the mine raise the impurities and complicate the sample. So a knowledge of the original form of the coal will greatly assist the analyst in deciding to what extent the sampling must be carried.

It is necessary to determine not only the amount of impurities but also to determine the probable error of any single determination, which in turn will tell how many samples are necessary to establish an average which will be within the allowable error, either fixed or assumed. In sampling coal no one method applicable to all cases can be carried out, but in sampling large exposed bodies of coal we hold that one large sample which requires some time to crush down and quarter allows too many chances for error, and the quality of the coal is the original body must be judged by the one analysis alone.

several small impartial samples had been taken ished and quartered down rapidly, which their have permitted, and a separate analysis made on verage of all the analyses would have represented the composition of the mass of coal than the analysis om the single sample. This has been proven by a tests carried out under the direction of Mr. Frank Haas, the testing department of the Fairmont Coal Company. example, from a large pile 100 small impartial samples of al were carefully taken and analyzed. Using the per cent. of sulphur for illustration the average of the 100 sulphur determinations were assumed to represent exactly the composition of the coal pile. Now if the analyses are taken in blocks of 10, starting with 1st, 10th, 20th; 2d, 11th, 21st; 3d, 12th, 22d, and so on, and the average of these blocks taken, in like manner blocks of 12, 15, 20 and 25 taken and the average obtained for each block of samples, a curve can be plotted, which will show at a glance how many samples must be taken in order to reduce the error to the allowable limit.

By this means we found that 20 samples must be taken in order to reduce the error to .10 per cent. or better. Of course, the personal factor of the analyst comes in, but by reducing the error on the sample we reduce the entire probable error.

If after determining the number of samples it is necessary to take in order to limit the error, the time and expense necessary to analyze each sample, are objectionable, a composite sample can be made by taking an equal part of each sample and thoroughly mixing. Using this sample for the laboratory analysis, results very close to the general average can be obtained.

In boiler testing the rules for coal sampling, as specified by the American Society of Mechanical Engineers, are about as follows:

One representative shovel full of coal is taken from each barrow load, placed in some air tight, covered receptacle at some distance from the heat of the furnace and in a cool place.

At the end of the test the large sample is crushed and quartered down in the usual manner for the laboratory analysis. This method of sampling gives only one large sample and the same objection applies in this case as before. If each one of the shovelsful had been taken as a separate sample perhaps some of the unaccounted for losses could have been itemized in another

place. The sampling of a coal mine presents another problem, but one which is comparatively easy if the rules and directions here given are followed closely.

Examine carefully the map of the mine and determine the location of points from which samples can be taken that will fairly represent the quality of the coal. Before sampling make a cut from the roof to floor of the seam, exposing a fresh surface of coal, unaffected by weathering or sulphur and smoke from the blasting powder. Clean the floor and spread a large piece of clean canvas or oilcloth to catch the cuttings. Then with a small sharp pick or chisel cut a channel in the face of the coal from floor to roof, the channel to be from 2½ to 3 inches wide and 1 to 2 inches deep. Do not cut out slate, bone coal or other impurities that it is the practice of the mine to reject. Place each sample in a stout canvas bag if it is to be analyzed at once, otherwise crush and quarter down the sample at once and place in a large air tight bottle or jar. The larger the mine and thicker the seam the more samples it is necessary to take in order to represent the quality of the coal.

As ash and sulphur are the only variables in samples of coal taken from a uniform seam, and since these have been known to vary from 10 to 50 per cent. in different parts of the seam, a complete analysis of each sample is necessary. The average of all the analysis will represent the "run of mine" from the entire seam.

By analyzing each sample separately the high and low ash and sulphur points are located and the coal can so be mined as to fit it for the purpose for which it is to be used. The actual operation of preparing the sample for analysis consists in crushing, mixing and quartering until about 100 grams remain, which is put through an 80-mesh sieve and placed in a small, air tight receiver.

With small samples this operation can be carried on very rapidly without any appreciable loss of moisture through air drying, thus avoiding the loss of time and extra calculations necessary when handling large samples which must be air dried for 24 hours or longer and the loss of weight figuring in the per cent. of moisture found by analysis.

The test of the coal that can be made in the laboratory consists in the proximate analysis, the ultimate analysis, the determination of the per cent. of the sulphur and phosphorus and the

calorific value of the coal either by calculation from the results of the ultimate analysis or by the use of some standard calorimeter.

Laboratory test can also be made on the coking power of the coal, the effect of washing on coal and the porosity of the coke. As previously stated, the proximate analysis is the most important test that can be applied in identifying the character of a coal or determining its quality.

The method universally adopted is that reported by the Committee on Coal Analysis of the American Chemical Society, and is too well known to be commented on here except to remark that it must be strictly followed, as any departure will lead to much variation in results on moisture, volatile matter and fixed carbon. In a laboratory where much work is done along this line and a large number of platinum and porcelain crucibles are available, a small gas or gasoline muffle furnace holding 10 to 20 crucibles will hasten and facilitate the analysis greatly.

For the determination of sulphur either Eschka's or the sodium peroxide combustion method is equally good. Where only a few coals are to be tested for sulphur, the sodium peroxide method is undoubtedly the most rapid, also the most expensive. For the ultimate analysis and other laboratory test any standard book on quantitative chemical analysis will give all the information necessary.

For work of this kind I have found Prof. N. W. Lord's "Notes on Metallurgical Analysis" to be of very great help. The notes and methods contained therein having all been tested over and over again, are rapid, practical, easy of manipulation and giving accurate results when properly handled.

I wish to thank Mr. Frank Haas, Chief of the Fairmont Coal Company's testing department, for assistance and information given in the preparation of these notes.

DISCUSSION.

MR. BERKLEY—It has lately been brought to my attention, and I think to that of others, that there is a lack of interest, that there is a lull. Having attended these several meetings, and observing the interest that is manifested in them, the evidence of which we see just now, when we are trying to get a body of our

assembly together in order to hear the memorials to our members who have departed during the year, we find our President constrained to hold off until more members are upon the floor. That is only an indication of the actual condition into which we as men of this Association are drifting. I say it with all kindness and candor, that if our success is to be true success it must be through diligence to the business of this Association at its called sessions, to press forward in its work, to prosecute with vigor all of its interests. Instead of being characterized, as I have heard some characterize us lately, a little bit slow, instead of having it said that others are gaining ground where we are losing ground; but on the other hand, may it be said that the Western is the most progressive, the most alive, up-to-date, thorough Gas Association in this country. There is no reason why, gentlemen, these meetings should not be better patronized by our presence. Such a paper as Mr. Wheeler's that we have heard read here this morning is indicative of the condition in which we find ourselves, because we are unable—and I feel my inability along with the rest—to enter into an intelligent discussion of a paper that leads and throws light upon the gas industry.

There is no use in our thinking or talking that our business is good enough and that our members are up to the standard. Opportunities are being made, avenues are being opened, and the result of it is that unless we as men take the opportunity by the horns and are equal to the dilemma in which we actually find ourselves placed, which is really dangerous ground, we will in time—not this year—be submerged and absorbed by some other power that is stronger than ourselves. We have some of us come many miles, some of us a short distance. If we will consider the interest which we represent the time allotted to the representation is short. With our action and energy devoted to it we would then accomplish much more than we accomplish because of our indifference. I know no other word that expresses it or that indicates anything of the sort which I wish to describe; it is simply indifference to attending sharply and promptly to business. On the other hand, we represent here men of salary, men of brains, whose time is worth something. If that is true, we should with pride and pleasure and profit come and sit and listen to what they have to say. It is a shame, my friends, that men will sit down and write papers and study hard to give us something

which we ourselves don't know, and then they will come here and the papers will be treated as we have treated the papers here this morning. I would have you bear in mind that this criticism I am offering to our Association as a body is from the kindest intention and the best spirit of brotherly feeling for we are on dangerous ground, in danger of losing what we once had, the greatest prestige, or what we still have and can maintain, the integrity of the Western Gas Association beyond any impressionable power that might be brought against it. Therefore, I respectfully ask, on behalf of the Association and as a member of it, that we prosecute with diligence the business that is here for us to do. Next year, when we come to the meeting, let us see that the printed matter is sent out earlier, that men are better posted on the subjects for discussion, and when we come here let us come to the business as we go to business at our several places. We would not hold our positions very long, we would not succeed very far, if we neglected our business like we neglect the sessions of this Association. So let us now make a resolve that next year when the President calls the meeting to order, we will be on the floor and take an active part, and that we will go away from here benefited morally, financially and spiritually, and through brotherly love and every other way that will lift us up. I thank you very much. (Applause.)

THE PRESIDENT—The next order of business is the

REPORT OF THE MEMORIAL COMMITTEE.

MR. DOTY—Mr. President and Fellow Members: It is my privilege as Chairman of the Memorial Committee to present to you our tributes to those members who have passed away since our meeting of 1904. Rarely in the history of the Association has the black border encircled so many names of such prominence as those we are called upon to mourn to-day.

Alpheus B. Slater, Honorary Member, died June 26, 1904.

William Henry White, Honorary Member, died July 3, 1904.

Oscar B. Weber, Associate Member, died September 16, 1904.

James Somerville, Past President, died February 13, 1905.

Charles Blodgett, Active Member, died August 25, 1904.

Charles E. Hess, Active Member, died December 22, 1904.

The President has requested that the individual members of

the Committee pay the tributes to the individual members. I will ask Mr. Thomas D. Miller to respond to Mr. Alpheus B. Slater.

Mr. Alpheus B. Slater.

MR. MILLER—This duty has been thrown onto me because Mr. Shelton, who had been assigned to it, could not be here and in saying what I do say, I can only speak from my personal knowledge and regard for the gentleman. It was in Chicago, in 1893, that I first attended a Western meeting. One of the men that I met at that meeting, who seemed to like me, and I know I liked him, was Mr. Slater. I never came in contact with him excepting at the Western Gas Association meetings. To my mind he represented what I regard as an ideal man. His generous nature, the interest he took in other people, his kind consideration for others and their feelings, were what made him the perfect gentleman. As to his career in the gas business, Mr. Shelton has written quite a biography, I understand, and mailed it here, but it has not yet reached me, and, therefore, it will have to appear in the printed proceedings. Mr. Slater, I understand, left a legacy to his children and a memory to his friends that is the greatest that man can leave, and that is the universal respect, regard and confidence of those with whom he has come in contact. Financially, I understand, that the wealth in dollars did not amount to much, and what does that amount to anyhow? The reputation and character that he leaves behind is something that cannot be taken away, and it means all for which life is worth living.

I am very sorry indeed that I am not able to present a more creditable talk on this subject, but you can understand that the duty was thrown on me suddenly, without any preparation. I am sure that as far as I have been able to go in the matter I have expressed the sentiment of every man who knew Mr. A. B. Slater.

The following tribute to the memory of Mr. Slater, by Mr. F. H. Shelton, was received too late to be read at the meeting:

For many years, in gathering at the annual meeting of the Western Gas Association, we have been accustomed to the constant presence of A. B. Slater. It seems strange not to have him with us now; and while the duty of speaking of him is a

melancholy one, it yet carries with it the pleasure of a tribute of affection and esteem in which he was held by the writer, who knew him long and well.

Alpheus Brayton Slater was one of the old school, New England gas men; one of the kind who pretended not to know much of the fourth decimal place, but who *did* know how to always keep his gas works going, and his company going ahead!

Born in New England in 1832, reared and educated in it, his entire life work practically was devoted to the gas business, and in that he established a name for sturdy integrity, and commercial success and ability that marked him as one of the foremost, practical gas men in the country.

He entered the ranks early. When but 21 years old he first engaged with the Providence Gas Company, and there is no greater evidence of his worth, and year in and year out dependability, than the fact that from that date, of 1853 (and that is a long time ago, as human lives go), until his retirement but a short time ago, he steadily served that single Company, rising by degrees, until for many years he was its recognized Engineer, Manager and practical head. Surely a life work of almost two generations is a heritage of which his sons may be proud.

Mr. Slater was one of the founders of the New England Association, and its President in 1882, 1883 and 1884; he was a founder of the Boston Guild of Gas Managers. In 1873 he joined the American Gas Light Association. Sixteen years later he was its President—in 1889. In 1902 he was fittingly made an Honorary Member.

In 1886 this Association, in honoring him by creating him an Honorary Member, honored itself; for it thus took into its ranks one liked and esteemed and respected by all.

Mr. Slater always seemed very fond of the Western Association. Rarely did he miss a meeting insofar as rested in his own power, and it needs no effort to recall his presence, linked arm in arm with Mr. Leach, his constant and faithful associate (and alas! now likewise also called across the great divide!) in the corridors of our meeting places, year after year. He often said to the writer that he looked forward to the yearly Western trip with constant pleasure; the change of scene, the things he picked up, the friendships made, and the good fellowship exchanged, abundantly repaying him for the long journey that it meant to him, from Providence, R. I.

The writer particularly remembers his cheerful presence in a party of 30 who went by steamship one year from New York to Savannah to attend a gas meeting there. On that trip he and I climbed to the crosstrees of the foremast, turned our legs around the shrouds and smoked by the hour, out of sight of land, miles from a gas works. but nevertheless swapping small talk about gas matters of common interest, the older man telling the youngster, what was what in a wholesome, lovable way that will never be forgotten.

Mr. Slater was not a great gas engineer from the extreme technical standpoint; he does not go down into American gas history as a great inventor, promoter or scientific man. But as one great in "horse sense" in practical success, in steadily building ahead and forging upward and in the human qualities that made him liked, he was one of the best gas men. Would that he were with us still!

MR. DOTY—Mr. William McDonald, as a member of the Committee, will respond for Captain White, always graceful in manner and in speech.

Captain William Henry White.

MR. MCDONALD—Mr. President and Gentlemen: When we think of Captain White we are apt, I fear, to think of him as a genial gentleman who did a great deal to amuse the members of the gas fraternity. No man, probably that was ever among us was so capable of amusing his fellow members in the Gas Associations, and yet I have often heard the Captain himself express regret that this was true, because he seemed to feel that, to a certain greater or less extent,it took away from him the character that he really desired to have before his fellow men. And so in what few words I shall say this afternoon, I shall as far as possible, portray to you a little different thought regarding Captain William Henry White.

At the meeting of the American Gas Light Association in 1879 I became a member of that Association. Almost the first man to welcome me into the body was the Captain. From that day until the day of his death we were warm personal friends, never but once having a difference of any serious character, and that among friends is always easily settled. At the banquet of the American Gas Light Association at Philadelphia in that year,

Captain White responded to a toast, "The light of other days." I presume there are quite a number of people in the room to-day, who remember that speech made by Captain White, and it was one that brought him to my notice particularly. It was a speech that was an honor to him. It had nothing of the light or frivolous in it; it was classical and intellectual. It was beautiful, so that my first impressions of Captain White were, that he was an educated gentleman who could speak in the most elegant way upon almost any subject that he undertook to speak about.

The last speech that I ever heard him make, and which a good many of you gentlemen heard, was at the meeting of the Western Gas Association a year ago, when he spoke of the death of General Hickenlooper. Now, if you will just pause for a moment and put together the thoughts that I have expressed, to those of you who heard his speech in Philadelphia at the beginning and the eulogy to General Hickenlooper at the end, it must give the impression that Captain White was something besides an amuser. I know him to have had a tender heart, ready at all times to help anybody that was in trouble. I know, as I said before, that he regretted he had had the name of being an amuser. He believed, as I believe, that, to a greater or less extent, a man makes a mistake to pursue a policy of that kind too far and too long, and he believed it detracted from the real manliness of character that he desired the people around him to consider he possessed. All through the years, if you will go back in your recollection, you will find the Captain was always tender-hearted. He was often asked to make a speech in remembrance of some of our fellow members, and he always did it in the most tender, the most beautiful way. If I had an ambition, one greater than another, it would be to stand here this afternoon and speak of Captain William Henry White as I have heard him speak of other men who were members of this Association. Gentlemen, I hope that we will bear in our hearts towards Captain William Henry White the most kindly of recollections, because he was a man among men, a gentleman of education and polish, and desired to be in every way what I imagine a man ought to be.

Just one word more, which I think is pathetic. It is a Western expression. He died with his boots on. You know what I mean. The Captain was a sick man for a year. No one knew how sick he was or had been; but he never complained. Up to

the last day that we met him he never said that he felt his time was drawing to a close, and he knew it well. He died without making any complaint, and with the good nature in which he had always lived.

MR. DOTY—I will ask another member of the committee, Mr. John D. McIlhenny, to respond for Mr. James Somerville.

Mr. James Somerville.

MR. MCILHENNY—Mr. Chairman and Members of the Western Gas Association: It is an honor to be called upon to speak of the life of James Somerville. Death came suddenly to him, in Indianapolis, on the morning of February 13th, 1905.

He was born April 1st, 1840, near the village of Stow, on the banks of Gala Water, Scotland. At the age of 17 he entered the Greenwich Gas works, London, under his uncle, David Hunter, the Manager, to learn the business of gas engineering. Four years later he was appointed Inspector at the Maidstone (Kent) Gas Works. At the age of 23 he was sent to Calcutta, India, where he remained 3 years, engaged in engineering work. He returned to England and was married at Maidstone.

He came to the United States in 1867 and after a few months' service with the New York Gas Company he went to Knoxville, Tenn., to rebuild and start the gas works destroyed during the Civil War. He remained as Manager of the Company at Knoxville for 10 years, and in 1877 went to Montgomery, Ala., where for 2 years he had charge of the gas works. He then became Superintendent of the Indianapolis Gas Company, a position he held until his death. He was one of the originators of the Western Gas Association and was its President in 1885. He was recognized as one of the best gas engineers in the country, and the new gas plant in Indianapolis is an evidence of his thoroughness in the profession.

He was an elder in the Fourth Presbyterian Church, a Director in the Y. M. C. A. and in the Commercial Club.

He leaves a widow and 6 children. Two of his sons are officers in gas companies, one in Chicago and one in Indianapolis.

Mr. Somerville stood high with his fellows and in his community. A local newspaper had this to say: "James Somerville was a modest, reserved and quiet man. He was exact and conscient-

ious. Above all, he was a Scotchman, fond of the land of his birth, of its history, its legends and its poetry."

The Board of Directors of the Young Men's Christian Association, of Indianapolis, stated of him: * * * "In our long association we always found him a Christian gentleman, so uniformly genial as to make us forget his years and feel that he was full of all the youthful vigor that could inspire the youngest of our number. His loyalty to us was unfailing."

The session of the Fourth Presbyterian Church, of Indianapolis, stated: * * * "No one could be more faithful in the discharge of duty. As a clerk of the session he was a model of punctuality and diligence. His liberality was proverbial. In church and business he did with his might whatsoever his hand found to do. His memory is fragrant of good deeds."

At the special memorial service, held in the Fourth Presbyterian Church, of Indianapolis, on March 2d, 1905, the pastor of the church spoke thus: * * * "The name of James Somerville inevitably suggests character. He had high ideals and severe standards. But his ideals were not beyond the realization of those who knew him, for they could see that he was attaining them. And if his standards were severe, they were never so severe for others as they were for himself. Consciously or unconsciously many who have come within the circle of Mr. Somerville's influence have been brought to adopt higher standards of conduct and nobler ideals of right living. No one who was trying to do right ever felt uncomfortable in his presence. I never knew a man so gentle and charitable in the judgment of others."

In his connection with the Indianapolis Gas Company, extending over a period of 25 years, he was ever ready to assist and advise others in his profession. He was uniformly beloved by his employees, the humblest of whom could approach him. Every man received justice at his hands. Many of his subordinates now occupy responsible positions in gas companies throughout the country.

Mr. Somerville had all the resolution, persistency and moral courage of his race. He frowned on insincerity and held to the belief that "Character is property and an asset of commanding value both in obtaining the confidence and good will of men as well as being a fortress of peace for himself."

At Agra in India is the world's most wonderful and magnificent mausoleum of Taj Mahal, dedicated to undying love. In the lofty dome is a wonderful echo. Voices from below ascend and roll and reverberate and come back to the hearers as one harmonious sound. Our voices raised in memory of our departed friend, James Somerville, we hope and believe will ascend higher than at the dome of Agra, to heaven itself and the echo will come back: "Well done thou good and faithful servant, enter thou into the service of thy Lord".

MR. DOTY—It is a privilege requested by one of the members of this Association, while not a member of this Committee—Mr. Berkley—to add his tribute to Mr. Somerville.

MR. BERKLEY—I want to say a word, gentlemen, because I was so closely identified with him. I feel that this is the last opportunity to voice a word in praise of him who to me is head high above most men. I want to say one thing about his helping. A few years ago he left the Tabernacle Church in Indianapolis, which was within 3 squares of his own home, and went out to the Fourth Presbyterian Church, then a mission, in order that he might help it. That church has grown until it is a power in that city because of his influence in it. I know of 12 young men that have left his works, and none of them, I dare say, have lived lives but what are commendable of the efforts that he put forth in trying to help them. I thank you for the privilege of adding my testimony to this grand and noble character.

MR. DOTY—I will ask Mr. John Gribbel, a member of the Committee, to respond for Mr. Charles Blodgett.

Mr. Charles Blodgett.

MR. GRIBBEL—Mr. President and Gentlemen: It is very meet that we who still move in the market places of life should pause a moment amid the traffickings to record the regard in which we hold the memory of those our fellows beloved, who have in silent caravans gone from us forever, leaving with us the gear and store of their living. With bared heads and tender hearts we set down the affection in which we held them and light the lamp of memory, that those who follow may know the pattern of the men they succeed and these our friends so continue to enrich human

lives. To those who knew him well the name of Charles W. Blodgett will ever be as the chimes of silvery bells.

He was born June 2, 1851, in Providence, R. I.

After his graduation at the College of the City of New York he entered the service of the Williamsburgh Gas Light Company, of Brooklyn, as assistant to his father, Charles F. Blodgett, who was the Secretary of the company from its incorporation until his death, covering a period of 35 years.

The son succeeded his father as Secretary in 1881. Some years later the manufacturing plant was also placed under his direction. The prosperity of the Williamsburgh Company under his direction was marked. While preserving his relation to the Williamsburgh Company, in 1890 Mr. Blodgett was appointed General Manager of the Brooklyn Gas Light Company, and later on elected its Vice-President. His labors were continued in both Companies until, on the consolidation of the several Companies in the city of Brooklyn, he was made Manager of the Williamsburgh district of the Brooklyn Union Gas Company. In this office he continued until 1901. He then went to the Providence (R. I.) Gas Company, as Superintendent, where he stayed until July, 1902, when indications of the disease appeared which caused his death on August 25th, 1904.

Coming of a line on his father's side, identified with the early history of New England, and on his mother's side from a stock which shared the glory and chivalry of the South, he embodied in himself, in an unusual measure, the characteristics of his ancestors.

His energy was as marked as his generosity. His tenacity of purpose was equalled by his vivacity. The solidity of his judgment was in no manner shaken by his rare quality of humor and his keen perception and analytical power were accompanied by a warm heartedness that made them welcome wherever he was known.

He was positive, but open to conviction. His devotion to truth was impassioned and equalled by the modesty with which he hid his personality. His capacity for friendship was rare and those of us who knew him best will cherish golden memories of it. In all his relations with his fellows he was moved by fidelity to a high ideal. Friendship with him was born of the heart and life brought him no fairer fruit. Life to him was real, intense,

practical, but not confined within these limitations. With him success was to be measured by achievement rather than by acquisition. In his scales "kind hearts" were "more than coronets and simple faith than Norman blood," and manhood was the real gold of Ophir. With all the sensitiveness of womanhood he combined a sturdiness and practicability which made him beloved, admired and respected in equal degrees.

He held the Western Gas Light Association, which he joined in 1890, in high regard. Some of us will long remember the positiveness with which he expressed his admiration of the spirit which moved this Association. He was outspoken in his admiration of its enterprise, its grasp upon the problems of our business and the comraderie existing among its members.

His record in our business as gas manager is one to be studied by the younger men who are to follow us and the quality of his manhood was such that his associates will forever cherish his memory.

MR. DOTY—I will ask Mr. George Clark to speak for Mr. Charles E. Hess.

Mr. Charles Emil Hess.

MR. GEORGE CLARK—Gentlemen, Charles Emil Hess was born in Hesse-Darmstadt, Germany, in 1839. At the age of 15 he came to America and located with his brother in St. Charles, Mo., where he engaged in a mercantile business, drifting from there to St. Louis and later to Phelps county, Mo., where he remained until the outbreak of the Civil War, when he returned to St. Charles. He enlisted in the Union Army. At the close of the rebellion he read law in the office of the Hon. A. Krekel, and later attended the Harvard Law School, from which he graduated in 1886. He engaged in the practice of law in St. Charles until his appointment as Registrar of Bankruptcy for the Western District of Missouri, which necessitated his removal to Jefferson City. After the expiration of the bankruptcy act he became interested in the Jefferson City Gas Light Company, which later merged into the Light, Heat and Power Company of that city, and for nearly 23 years he was identified with that corporation, until his death on December 22d, 1904.

Mr. Hess was a man of sterling integrity, a good citizen, observing a strict devotion to business, humane and just, a great lover

of nature, and possessed of a wide range of culture. In every relation of life he was a true and honorable man.

Mr. Oscar B. Weber.

MR. DOTY—To some, death comes like sleep at the close of a busy day, but to one it came at noon's high tide, and for him your President has asked me to give something more than a passing notice.

Oscar B. Weber was a New Yorker by birth and education. He was born in New York city, August 6th, 1859, and was graduated from the College of the City of New York in 1880. His business experience began with his father, Adam Weber, one of the first to manufacture fireclay retorts in this country, and who has been prominently identified with gas interests for more than half a century. The name of Weber has long been an honored one in the gas industry. Upon the retirement of Adam Weber from active business life in 1890, Oscar Weber became President of the Company known as Adam Weber's Sons.

The large, model plant erected at Weber, N. J., in 1891, is a monument to the importance of the manufacturing industry he represented. The nature of this product brought the Company, and Oscar Weber as its representative, into business relations with many of the gas companies and their officers, and to some the relations were intimate, and to those perhaps more fully is known the loss sustained in his premature death.

Mr. Weber was a member of the American Gas Light Association and of the Pacific Coast Gas Association, as well as of the Western Gas Association, and was faithful in his attendance at the various conventions and responsive to their varying demands, and I think we all felt a convention without him, left a vacant chair. He was full of good fellowship, with a personality strong and vigorous, and though it was understood that he was not well when attending our meeting of last year, yet to one of his temperment, disease seemed like a garment, lightly worn, to be thrown aside to-day, to-morrow. Who would have dreamed then that his summons had come? We who were fortunate enough to be the companions of his leisure, will recall again and again the marvel of his musical accomplishment. His was no ordinary talent, whipped to expression by a master's training, but a free gift from nature, as spontaneous as the song of a woodland bird, withal a

perfect co-ordination of hand and brain to deliver, to interpret the master's meaning.

THE PRESIDENT—Gentlemen, I think that we all feel that these few minutes devoted to the memory of our dead are well spent, and that we can pause in the transaction of our business to remember those that have gone before and whom we will surely follow. We will now listen to a paper by Mr. N. D. Cochran, of Toledo, O., on

AN IDEAL CORPORATION.

Mr. President and Gentlemen: Before starting to read the paper I desire to say that I have no special knowledge of the gas business, and am not here to try to tell you anything about it. What I shall say on the subject of corporations will be with reference to corporations in general.

The best thing that can be said of this century is that, more than ever before the ideal of the people is universal peace, and that means the organization of the world. The universal demand is that nations quit fighting and settle their differences by peaceful arbitration.

Reduced to commercial terms, that means that competition between governments must cease, and co-operation take its place. The universal government trust, if you please—the United States of the world.

That is the ideal terrestrial corporation, for it could be the *whole thing* organized. But first there must be organizations of the part. And each individual's task is to do what he can to organize his part, to establish the right relation between himself and the universe.

There is an ideal relation between you and your wife, your child, your friend, your neighbor, your community, your State, your country, your world, your universe. At one time or another the average man is at war in some degree with all of them. When he is at peace with them all that's the millenium.

The whole thing is made up of related parts or facts. There is the religious fact, and Christianity, Judaism, Mohammedanism and Confucianism are opinions as to what the religious fact really is. When we find *the* fact there will be one religion. It was only this week that John D. Rockefeller suggested the religious

trust, although the Congress of Religions at Chicago in 1894 pointed to the same thing.

There is the language fact, of which English, German, French, Russian and Japanese are but opinions. Yet commerce is forcing the language merger every minute. The locomotive, steamship and electric wire are weaving the people of the earth together. Commerce demands one language.

There is the credit fact, of which Dun's and Bradstreet's are but competing opinions. Neither is wholly right, or both couldn't exist. You buy both guesses and then take a guess on your own account.

There is the oil fact, which has more nearly arrived than any other industrial fact, for competition has been almost entirely eliminated throughout the world. And it is possible that future generations may forget the small dealers Rockefeller crushed, in his war to eliminate competition and organize oil, and give him some credit as the rough-house apostle of oil peace. Men may think more *then* on the result, and less on how it was accomplished.

Oyama is killing thousands of Russians and desolating many homes. But we think the sacrifice is made for universal peace and Oyama is a hero.

On the political government side the most interesting progress is being made towards the universal postoffice. It is interesting to note in this connection that the private express company money order is well nigh universal. The U. S. post office money order is not.

One of the most interesting American facts is the railroad fact. Once every road was a separate corporation, or opinion. Competition, or war, taught its lesson and the railroads got together in groups. The wars of these groups between themselves and the public, or government, will compel railroad peace. Competition is responsible for rebates, drawbacks, passes and other special privileges. Organization and peace will eliminate them.

Just how railroad peace will come remains for the future to reveal, but if each step toward better organization be orderly we need not worry about what the ultimate will be. But the war has gone far enough to demonstrate that the organization is not complete when relations between railroad employers and employees have been adjusted. The railroads have their wars with labor,

and great progress has been made toward peace, so far as that particular relation is concerned.

But there is a third interest. The war now on is between the railroad organ—all the railroads—and the other parts of our social, commercial and industrial organism. That means that a right relation must be established between this one part and the whole. There can be no peace until everybody is protected from the possibility of the arbitrary and unjust exercise of great power by anybody.

I have placed emphasis on the railroad relation because of the peculiar interest it has to the particular class to which this paper is addressed. All of the so-called public service corporations now face the same problem. Not only must the right relation between employer and employee be established, but the right relation between them as a harmonious corporation and all other interests—the remainder of the people, the general public—must be established also.

I have read with much interest that part of the proceedings of the Congress of Gas Associations of America at St. Louis last year which concerned the relation of gas companies and employees. The discussion which followed the presentation of the experience of Sir George Livesey and the South Metropolitan Gas Company, of London, in profit sharing with employees, indicated a disposition on the part of some American gas managers to bring about a more equitable and satisfactory relation between employer and employee in this country. It indicated also that there is not so much greed and narrow selfishness in the ownership and management of some of our public service corporations as many of us have been led to believe; and that there is a growing demand for peace in the gas business.

It indicated even more than that. It indicated that some corporations are developing a soul; for at least three of the gas men who discussed the paper made specific mention of the Golden Rule, and in connection with the gas business.

So far, so good. When employers go earnestly hunting for an ideal relation with employees they will improve conditions, even though they don't reach the ideal all at once. And having established a better relation with employees, they will then be in better position to establish a better relation with the public.

And the war is on now. Competition taught gas men that two

gas companies in one community were just as absurd as two post offices. Once they got that wise there was better organization. But the same mistake was made in some communities that other industrial organizers made. Complaint has been made in some instances, where public service corporations were recognized, that values were inflated and capitalization watered.

Against that the public has declared war. There is a demand for so-called municipal ownership, that will grow in proportion as the public service companies get out of relation with the public. Before this war is fought out there must be more organization—the water must be organized out of the capitalization and public confidence organized in.

The growing demand for municipal ownership isn't because the public crave it as a beverage, but rather because they feel that some sort of emetic or cathartic is needed to establish better social health. It is a war measure. Like all wars this one will be educational, and more progress will be made toward peace.

This is an opinion, of course. It is not expressed in the spirit of captious or hostile criticism, but rather in the hope that it may help in some measure to bring about gas peace.

Resistance is a great thing when it is right. Protest has worked wonders in organizing the world. The best thing now happening in the industrial world to both labor and capital is the resistance offered by each to the encroachments of the other. Resistance makes you stop, look and listen. When you start wrong it helps you to back up and start right.

Believing in organization, I believe in unionism. I believe in the corporation and in the labor union. Instead of too much organization there is not enough. A big, strong man; chesty with conceit and power, may thump his weak and puny neighbor, but he is more apt to shake hands with a fellow of his size and give him a square deal. Right organization means a square deal for everybody.

That's what all this row in Chicago is about. The employers and employees in one special industry went to war, and others thought it could be fought out in that one spot. But they overlooked the intimate relation of parts of organized society to each other and the whole, and finally the entire community was in it. You can't rob Peter to pay Paul. And you can't hurt Peter without hurting Paul, and yourself also.

In the war right here in Chicago one of the most significant developments is the palpable inefficiency of municipal government. It has failed to govern. The political government has been unable to adjust the relation between industrial classes. Hence Chicago cannot be called an ideal municipal corporation, although I think it is one of the most progressive municipalities in this country.

In a general way this paper has pointed to more than one ideal corporation, although time will not permit the working out of any of them in all its details. I will attempt to point out, however, the dim outlines of the ideal municipal corporation, and with that leave the rest to your imagination.

I believe first of all that our so-called representative government is a failure simply because it is not truly representative. Society is industrial, commercial and social, but its government is political. The community is made up of bankers, manufacturers, clerks, merchants, book-keepers, skilled mechanics, laborers and others who do something useful to earn a living, but when they come to select their representatives they choose from Democrats or Republicans. And neither of these seems to have any real relation to everyday life.

In many municipalities the representatives represent those who will pay the highest price for representation, and they are generally the seekers for special privileges.

The subdivision of a municipality into wards is purely arbitrary and geographical. No ward representative can know what he really does represent, except his own aims and ambitions. The community isn't organized. It is merely divided into wards and all kinds of peoples into Democrats and Republicans.

Everywhere we find dissatisfaction with this kind of governments. Where shall we turn for something better?

While politicians and statesmen are tied down by precedent tradition and superstition, commerce is evolving the new government right under their noses. The fierce war between capital and labor is a war of conflicting opinions, a fight for better government that will regulate the relation of individuals and classes, and to insure to every man the right to do as he pleases as long as he does not interfere with the right of every other man to do the same thing. We find this same war going on in every class interest, this same cruel, disastrous yet educational and peace-

compelling war. But everywhere there appears to be a tendency on the part of men to get together in peace and harmony as rapidly as they can intelligently adjust relations. There is a tendency to get together in classes—not the old classes to which membership was attained through wealth or the accident of birth —but classes in which membership is determined by special knowledge, fitness and enlightened self-interest.

There was a time when every State in this Union was an individual opinion. It took war to weld them together. Many thousands of precious lives and many millions of treasure were sacrificed, but the result was good. We have seen the gradual organization of them all into one great, harmonious union, each reserving the right to develop its best individuality, but a supreme human intelligence governing and regulating the relations of each to every other and to the whole.

We boast of this representative government as a vast improvement over the monarchial form. Yet it seems that commerce is evolving a government that will be a vaster improvement over the so-called democratic republic than that was over the absolute monarchy.

So much for the general proposition. Let us take up the relation of the lighting industry to the public. That brings us to the ideal municipal corporation and government fact.

This Association is but one of the many evolving from the same principle. You are moving toward the nationalization of the lighting industry. You are working toward a supreme governing gas intelligence, without a sacrifice of the individuality of the constituent corporations. This supreme gas intelligence will be a great clearing house of gas facts and information. Each member will help every other.

Let us suppose the gas light industry in a city organized to its highest possible development. It is one industrial organ of a social and industrial organism. Then let us take every other organ and nurse that to its highest development. We will have then the street railway or transportation organ, the banking or credit organ, with the banking system unified as the post office is, the Central Labor Union, the health organ and the organ of food, clothing, shelter (landlords), tenants, builders, breweries, saloons, religions, charitable, correctional and reformatory, fire, police, public service, public safety, retailers, publicity, advertisers, etc.

Then let us suppose that each industrial class, or interest, or organ, elects its best representatives to a central clearing house, the supreme intelligence, the governor of relations between the organs, or interests and individuals. Does not that mean government of the real best people, and by developing each class interest to its highest, develope the social whole to its highest and best? Would we not have then a community governed by organized intelligence, and industrial democracy?

I offer this as a government that would be better for the community than public ownership under existing forms of governments, and better for private ownership that is honest and wants to earn money by intelligent operation and management of its industry. And no book or legislative laws would be necessary to put it into effect. It would be a law unto itself and automatically control government from the jump; for every member of the governing body would be a real representative of his class interest. Each class interest could be, and would be, given the greatest possible liberty consistent with the rights of all. And the relations of all would be regulated by the highest intelligence in the community.

It would be the department store with every department in charge of an expert, and all heads of departments constituting the supreme intelligence, as against a general store not divided into departments but every clerk a jack-of-all-trades. And that is what our government is now.

Under public ownership, as now advocated, it is intended that the butcher, the baker, the candle stick maker and the banker, the sewer digger and everybody else, shall select the management of the gas company, the street railway company, etc. Under private ownership we have the abuse of watered bonds and stocks, and gigantic grafting that not only keeps up constant warfare with the people but interferes with the scientific operation of the plant.

Private ownership, unregulated except by the promoter's greed, is wrong. If it were right this outcry wouldn't be heard. But the people begin to realize that there are other ways of paying taxes than to the elected treasurer. They begin to see that their gas bills and their street railway fares are taxes And they will not forever submit to taxation levied to pay interest on watered bonds or dividends on watered stock.

DISCUSSION.

THE PRESIDENT—Gentlemen, we have listened to a very eloquent and earnest paper on "An Ideal Corporation." Mr. Cochran's idea seems to be that but one corporation should exist. If that condition could prevail, the conditions would certainly be extremely ideal, and we would all be employees of a corporation. All the associations which we attend would lose much of their individuality. I would like to hear a little discussion on the subject.

MR. DOTY—Mr. President, I think that the Western Gas Association can congratulate itself upon having had the opportunity of listening to the address delivered by Mr. Cochran. Mr. Cochran is a newspaper man. I believe he would value that title higher than he does the fact that he is the editor of one of the most prominent newspapers in this country. You see he is a man of great courage, as is evidenced by the fact that he would actually come before an assembly of gas men; but you see, Mr. Cochran, they are not such a bad lot of men, and these men do have ideals, and these men, as I know many of them personally, stand for what you have expressed, and what President Roosevelt has expressed, as a square deal. We do want a square deal. We believe in education. We believe that the strength of our companies, the securities of our investment, depends upon closer relations—ideal relations, if it were possible, with our consumers. I believe I express the sentiment of gas men when I say that we desire nothing better than a close, intimate understanding of our relations to the public and the relations of the public to us. The obligation is mutual. We invest our money in an attempt to supply the public with a necessity, and for that investment all we ask is a square deal. Now, I consider that Mr. Cochran's address marks an epoch in gas association work. I think that when we have the opportunity of reading Mr. Cochran's address at our homes, in our moments of leisure, and have the opportunity of pondering, studying and reflecting upon the truths that he has advanced, we will feel very grateful indeed that he has spared a few moments of his very busy time in coming to Chicago and taking part in our deliberations. (Applause.)

THE PRESIDENT—Will some other gentleman speak on this subject? It has been a very interesting paper, and we would like

to have a free discussion. Mr. Cochran seems to have covered the subject so completely that it cannot be discussed. I would ask him if he wishes to make any further remarks.

MR. COCHRAN—Mr. President, I would just like to say a word in conclusion. First of all, I want to thank this body of men for the opportunity to address them. I agree with what Mr. Doty has said and if it was not a body of intelligent, representative men there certainly would be no satisfaction in coming to Chicago to talk to them. No man could get any satisfaction out of talking to a lot of wooden Indians. If he has got anything in his head that he thinks is worth saying, he likes to say it to men who have the intelligence to appreciate it if it is good, and to knock it down if it is bad. I can remember that when I was very young in the newspaper business I thought my special mission in life was to knock down every head that stuck itself up in front of me in opposition. As I grew older I found that every individual with whom I came in contact generally had a whole lot more good in him than bad. I believe that agitation such as these discussions will do much to bring a better understanding between people who are fighting now. There is fighting to a certain extent between the public and the corporations. It may be said that on a lot of these things you know a whole lot more about it than we do, and we may be wrong—I am now speaking from the other side—but the way to do is to convince us. We are always ready to be convinced. I believe the great majority of men are fair; they want to be fair. I believe in war to a certain extent, because when people fight they get tired of it sooner or later, and it generally convinces. If a man gets a good licking, he thinks twice before he goes into another fight. I believe that we are evolving all the time a better condition. I believe we are working towards a situation that means peace between corporations and the public. The people don't stop to think that they are a corporation themselves. While I am speaking from the outside, I am one of the greatest enthusiasts about corporations that there ever was, because if I could I would organize every body on the face of the earth into one harmonious fraternal organization. (Applause.)

MR. DOTY- I move, Mr. President, that the thanks of the Association be tendered to Mr. Cochran for his very valuable and very able address. (The motion was seconded and adopted.)

THE PRESIDENT—Mr. Cochran, it gives me great pleasure to

thank you, in behalf of this Association, for your very able paper. Gentlemen, the next order of business is the election of officers for the ensuing year. Nominations are now in order. The first office to be filled is that of President.

NOMINATION OF OFFICERS.

MR. MCDONALD—I nominate Mr. Doty.

MR. MILLER—I second the nomination, Mr. President.

THE PRESIDENT—Any further nominations?

MR. HOWARD—Mr. President, I would move that the Secretary be authorized to cast the vote for Mr. Doty as President of this Association. (The motion was seconded and adopted.)

THE SECRETARY—Mr. President and Gentlemen, in accordance with your instructions I cast the unanimous vote of the members assembled for Mr. Paul Doty to serve as President for the ensuing year. (Applause and cries of "Speech.")

ADDRESS OF PRESIDENT-ELECT DOTY.

Fellow Members of the Western Gas Association: This is not an extemporaneous speech. I feel very deeply. You have by your votes elected me President of your Association— our Association—for the coming year. I am deeply appreciative of this mark of your esteem. It makes my heart beat a little faster; it makes the blood course through my veins a little more quickly. I thank you sincerely for the confidence you have manifested and I pledge my services for the whole welfare and good of our Association.

I feel I should make this an occasion for a heart-to-heart talk, something more than a perfunctory expression of my thanks. You have given me your votes. I want something more than your votes. I want your brains, your hearts, to make my administration a success. I appeal for your whole support. Do not make the Presidency an empty honor. Do not envy me that honor. I know full well that each added duty brings an added responsibility, but I welcome the duty as an opportunity of great value. You must join with me in making the most value of the opportunity. I appreciate, you know, that the great man in the world's work to-day is the co-operative man, the man who sees clearly the right thing to be accomplished and is willing to

sink his individuality to accomplish it; the man who is more interested in getting the work done than he is in getting credit for doing it. I think I am right in claiming that the spirit of the Western Gas Association is the spirit of co-operation. Its members are co-operative members. Its policy is democratic. Its government, as I understand democratic to mean, is of the members, by the members, and for the members. This being true, the opportunity to do effective work is yours as well as mine.

If you will refer to the By-Laws of the Constitution, Article IV., Duties of Officers, Section 1, you will read that "The President shall also choose subjects and select authors for the papers which shall be presented for the consideration of the Association at its next annual meeting." It is my duty therefore to present subjects to you, and your duty to consider these subjects for the papers to be presented at the next annual meeting. Let it be understood if we do our full duty to the Association our work for next year begins now, and not a few weeks before the next meeting. An American characteristic is preparedness. This being true it will only be necessary for me give passing mention to the necessity for an early campaign for 1906. But do not forget that I say the campaign begins this minute. The command now is "Attention." At the close of this meeting it will be "Forward —March."

I have here the card index of "Current Gas Literature" as published by "Progressive Age." I have had a list made of the number of papers indexed under the following subjects. The index has been carried on for but a little over 2 years and you will be surprised no doubt as I was, to know that already there are over 2,940 references to over 229 subjects. I will not read all the subjects, but will incorporate them in the proceedings, and you will, I believe, be proud to know our industry is so active in technical work and literature.

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Employees, 24.
Engines, gas or oil, 199.
Engineering, 14.
Enrichment, 6.
Ethics, 1.
Excavating, 2.
Exhausters, 2.
Exhibition, 3.
Experience, 2.
Explosion, 10.
Exposition, 3.
Extensions, 2.
Fans, 11.
Filing, 1.
Financial, 13.
Fire, 8.
Firebrick, 3.
Fixtures, 3.
Fitting, 4.
Flames, 1.
Flow of air and gas, 13.
Flue, 1.
Formulæ, 1.
Foundations, 1.
Franchise, 6.
Fritz, J. (medal), 1.
Fuel, 31.
Furnaces, 3.
Gauge, 2.
Gas, 3.
Gasoline, 1.
Governors,
Graphite, 1.
Gravity, 1.
Handling, 2.
Hazard, 3.
Heat, 30.
Heating, 37.
Historical, 15.
Hoisting, 3.
Holder, 14.
Humphreys, 4.
Hydraulic, 1.
Hydrogen, 2.
Hygiene, 9.
Illumination, 19.
Incandescent, 61.
Index, 12.
Industry, 6.
Inspection, 5.
Invention, 2.
Iron, 1.
Journals, 1.
Labor, 28.
Lamps, 27.
Leakage, 19.
Legal decision, 6.
Legislation, 2.
Lighting, 141.
Loss, bad debts, 1.
Lowe, new oven, 1.
Lutes, 3.
Mains, 16.

Maintenance, 1.
Management, 16.
Mantles, 55.
Mass. Bd. Comrs., 1.
Manufacture, 3.
Measures, metric, 1.
Mediocrity, 1.
Mechan. handling, 22.
Meters, 49.
Methane, 1.
Mineral prof., etc., 2.
Mixer, gas, 1.
Mixture of gases, 1.
Moisture in air, 1.
Monazite, 6.
Municipal, 36.
Naphthalene, 20.
Natural gas, 21.
Nernst lamps, 12.
Obituary, 4.
Oil, 58.
Osmium lamp, 6.
Oxygen, 1.
Paint, 8.
Paper, 1.
Paris, France, 12.
Patents, 1.
Paving, 3.
Petroleum, 2.
Philadelphia, 1.
Photometer, 89.
Photography, 1.
Piles, 1.
Pipe, 35.
Power, 18.
Pressure, 20.
Presidents, 1.
Prices, 14.
Producer, 44.
Progress, 4.
Pumps, 6.
Purification, 56.
Pyrometer, 10.
Question Box, 8.
Radium, 1.
Regulation, 5.
Retorts, 110.
Research, 1.
Residuals, 1.
Review, 3.
Roof trusses, 1.
Rope, wire, 2.
Rust, 3.
Sandblast, 2.
Scrubber, 13.
Separator, 3.
Service, 1.
Smoke, 7.
Specific heat gravity, 2
Specifications, 4.
Standpipes, 1.
Standards, 3.
Statistics, 31.
Steam, 65.
Steel, 3.
Strike, 1.
Stoves, 22.
Sulphur, 14.
Tanks, 1.
Tar, 41.
Taxation, 4.
Telephones, 1.
Temperature, 28.
Testing, 2.
Thorium, 1.
Transporting, 1.
Trenches, 1.
Tunnels, 1.
Turbine, 7.
Vapors, 1.
Vegetation, 1.
Ventilation, 4.
Washer, 1.
Water, 1.
Water gas, 85.
Water power, 1.
Wind (pressure), 2.
Wood, 1.
Works, 133.
Wrinkle, 4.
Writing, 1.

I have also made an analysis of subjects in the 1905 issue of the Question Box of the Ohio Gas Light Association. You will agree with me that the work of our sister association is worthy of our praise and commendation. I look upon it this year as a barometer of the gas industry. It shows the range of pressure and where we can find the interests of our associates. There are 36 questions asked, or subjects introduced under 18 heads as follows

List of Subjects.

1. Gas making materials, 15.
2. Manufacturing equipment, 50.
3. Manufacturing operation, 96.
4. Residuals, 30.
5. Manufacturing chemistry and physics, 41.
6. Storage, 7.
7. Distribution supplies and material, 13.
8. Distribution operation, 41.
9. Chemistry and physics (other than manufacturing), 52.
10. Gas engines, 81.
11. Gas burning appliances (other than engines), 63.
12. New business methods, 19.
13. Collections and dealings with consumers, 9.
14. Accounting (other than collections), 4.
15. Management, 22.
16. Legal matters, 3.
17. Literature, 7.
18. Miscellaneous, 14.

Unanswered.

11. Is gilsonite or similar material used as an enricher?

53. How many installations of direct fired benches are there in America? Where are they?

97. Why are not coal gas retorts molded under high pressure, similar to making retorts for zinc distillations?

177. Can anyone give an actual experience with isolated generators in relation to coal gas bench work?

220. Other conditions being the same, CO is formed more readily above atmospheric pressure, rather than below it. What conditions determine the thermal efficiency that may be attained by working water gas generators under increased static head while maintaining differential pressures as at present?

225. Has the question of a standard candle power ever been discussed at any gas meeting, and with what results?

640. How much will damp air affect the heating quality of gas in a blast furnace?

651. Have you ever calculated the chimney draft by formula, and checked with actual observations by thermometer and draft gauge? Give your figures.

1,002. What proportionate relation should the pay roll bear to the net sales of gas appliances under the conditions specified in question No. 1,001? (Sales, $60,000 or less.)

1,157. What are the best dozen paper in the technology of gas that have appeared in the gas journals or association proceedings to be recommended to a man who has newly entered the gas business?

856. What is the best type of an aspirator and what is the efficiency? What air pressure does it take to overcome a certain back pressure in mixing chamber (say 7 inches) for different mixtures of gas and air?

Incomplete Answers.

86. Why do we not pay more attention to vapor tensions in designing coal gas condensing systems?

98. Has experience with vertical retorts to date been satisfactory or otherwise?

569. What is the actual cost of maintenance per lamp per year in street lighting systems, using single burner Welsbach gas lamps, including interest depreciation and fuel, where artificial gas is used at $1 per M.?

578. What are the different arrangements for tapping services; also the pressure reducing arrangements on high pressure main, say, 50 lbs.?

859. Is there any material, having greater heat conductivity than firebrick, which could be used for muffles, etc., for small industrial furnaces?

1,061. Has anyone tried to apply the Taylor system of shop management to gas operations.

1,151. In the interests of a better index, what criticisms can be offered in the card index sent out by the Western Gas Association.

1,155. Where can authoritative tables be found giving the temperatures under which petroleum and its many distillates becomes permanently fixed gases?

Differences of Opinion.

64. Why do we use such large retorts for such small charges?

70. Which form of oil spray for a double superheater carburetted water gas apparatus is the best, an injector at the head of the carburetter with no steam and under pump pressure of about 20 pounds, or an oil burner type at the head of the generator with

steam directed at the connection between the carburetter and generator?

84. Is a cement floor preferable to an iron floor for the charging stage of a retort house?

95. What are the advantages of "through" retorts.

152. Is it good practice to mix coal gas with water gas in a water gas relief holder?

190. What are the arguments for a thin charge of coal in the retort, and how do these stand in the face of practical carbonization of coal in by-product ovens?

203. In water gas practice, is it desirable to use more wash water than an amount necessary to maintain seal and carry off tar?

221. What is the effect of heating the oil on gas and gas making, using Texas gas oil, 27° gravity? What temperature gives the best results?

451. What is the best holder paint? Has graphite paint any advantages over red lead paint.

602. Is there any difference, and if so, what, between the amount of flow of a jet of gas lighted and unlighted?

604. An increase in temperature of either air or gas, or both, before being burnt, gives a flame lower in temperature than if colder gas and air are burnt, other things being equal. Do you think this statement is correct?

605. In combustion, which has the oxygen the greater affinity for, the carbon or hydrogen?

832. Have any gas companies had experience with aluminum tips? How do they compare with the old lava or steatite tips?

You will note the greatest interest is in the "Manufacturing Operation," 96 questions, closely followed by "Gas Engines," 81 questions, and the least interest is manifested in "Legal Matters," 3 questions, and "Accounting (other than Collection)," 4 questions. I have also had a list prepared of the unanswered questions, 11 in number; incomplete answers, 8 in number, and differences of opinion, 13 in number. This speaks volumes for the efficiency of the Question Box as a machine. With 567 questions submitted only 11 remain unanswered, or 2 per cent., or an efficiency of 98 per cent., or if we add the questions having incomplete answers 8, another 2 per cent. may be deducted from the efficiency. We may agree, however, that we can find 32 subjects

for answers or reports from the work of the Question Box. I will not read all the questions but will record them for reference. Some of the questions are of much importance and will repay investigation.

In addition to the analysis of "Progressive Age" index and the Question Box of the Ohio Gas Light Association, I desire to submit further subjects for your consideration.

Utilization of tar in water gas machines.

Removal of naphthalene by the scrubbers.

The complete analysis of hydrocarbons in our gas.

Carbonization of coal for plants not large enough to put in complete charging and drawing machinery.

Scrubbing and condensation as affecting candle power and investment.

Simple means for dehydrating tar.

Commercial and engineering investigations on how to sell our ammonia and to obtain better results.

Fuel Economies.

Increasing the capacity of present water gas apparatus.

Purification of gas by ammonia.

Increasing the capacity of present purifying boxes.

Analysis of gas accounts by the use of the Hollerith system.

Intensified gas burners for street lighting.

Best methods for the removal of oil tar from water gas.

How to determine the proper law for the flow of gas in pipes and the effects of bends.

Dehydration of gas.

Standardizing of coke sizes and nomenclature.

Coke handling apparatus.

Temperatures employed in water gas manufacture.

How to increase the yield of gas coke.

Use of coke breeze in water gas generators.

Tar macadam.

Handbook of instruction for gas company employees.

Investigation of Bunsen burner designs.

Method of determining the relative value of gas business.

Developments in securing industrial fuel gas business.

What special appliances have been developed and put in use to meet the requirements of the industrial people.

Retort scurfing.

Improvements in design for a distribution system.

Experiences with "universal" pipe.

Service governors.

Best retort house construction.

Best machinery for charging and discharging retorts.

I will not tire you with giving additional subjects. This list, however, can be made much longer. Your own experience can suggest other subjects. But from the above you can see that the problems before the gas industry are important and call for renewed energy and perseverance. In a general way let me urge consideration of the subject of gas rates. A campaign of education can be started none too soon to enlighten the public upon "reasonable rates."

The subject of railroad rates is now much discussed. It may be our turn next. Do we ourselves know all we should upon the proper presentation of this problem before the public mind?

How can the gas business be made more profitable? This is a question involving many factors. Do we know all the factors influencing consumption and earnings? I think we have much to learn.

Never to my knowledge has there been such a demand as at the present time for workers in our chosen industry. Problems pile up faster than solutions are found. The individual cannot do the work unassisted. By co-operative work alone can we hope to succeed. We have the problems, we have the men, we have the Association. Give me your enthusiastic support, your loyalty, your energies, and I promise you your associates will confer honor and dignity upon you, and you will value most highly the opportunity that is yours by virtue of your membership, your companionship in the Western Gas Association.

ELECTION OF OFFICERS.

THE PRESIDENT—Gentlemen, the next office to be filled is that of First Vice-President. Nominations are now in order.

MR. MCILHENNY—Mr. President, I nominate Mr. K. M. Mitchell for the office of First Vice-President. (Seconded,)

THE PRESIDENT—The nomination of Mr. K. M. Mitchell has been made. Any further nominations?

MR. STEINWEDELL—I move that the nominations be closed,

and that the Secretary be authorized to cast the ballot of the Association for Mr. Mitchell. (The motion was seconded.)

THE PRESIDENT—It has been moved and seconded that the nomination be made unanimous, and that the Secretary cast the ballot of the Association for Mr. K. M. Mitchell as First Vice-President. (The motion was adopted.)

THE SECRETARY—Mr. President, I cast the unanimous vote of the members present for Mr. K. M. Mitchell, to serve as First Vice-President of the Western Gas Association for the ensuing year.

MR. MITCHELL—Gentlemen, I am not a public speaker, but I want to thank you for this great honor, and I promise you that I will do the very best I can for the interest of our beloved Association. I thank you.

THE PRESIDENT—The next office to be filled is that of Second Vice-President.

Mr. STEINWEDELL—I would like to nominate Mr. D. R. Warmington, of Cleveland.

THE PRESIDENT—Mr. Warmington is placed in nomination.

MR. LYNN—I would nominate Mr. W. A. Baehr, of St. Louis.

THE PRESIDENT—Mr. Baehr is placed in nomination. Any further nominations? It has been moved that the nominations be closed, (The motion was seconded and adopted.) Nominations are closed. As long as two names are in nominatian it will be necessary to cast a ballot and appoint tellers. I appoint Mr. Wm. McDonald and Mr. Butterworth as tellers. Gentlemen, the question has been asked if associate members have the right to vote for officers. By reference to the by-laws you will find that associate members have all the rights of active members, except the right to hold office. Associate members can vote. (A ballot was taken.)

MR. MCILHENNY—Can't we proceed with the next order of business while the ballots are being counted?

THE PRESIDENT—I imagine so; yes. The next officer to be elected is the Secretary. Nominations for Secretary are now in order.

MR. MCDONALD—I nominate Mr. Dunbar.

MR. MCILHENNY—I second the nomination of Mr. Dunbar.

THE PRESIDENT—Mr. Dunbar has been nominated for Secretary for the ensuing year.

MR. MCILHENNY—I move that nominations close and that the President cast the ballot of the Association for Mr. Dunbar as Secretary.

THE PRESIDENT—You have heard the motion, gentlemen, that the nominations be closed, and that the President cast the ballot of the Association for Mr. Dunbar as Secretary. (The motion was adopted.) I take great pleasure in casting the vote of this Association unanimously for Mr. Dunbar as Secretary for the ensuing year. Before announcing the result of the vote for Vice-President I think we had better hear from our newly elected Secretary.

THE SECRETARY—Mr. President and Gentlemen: The greatest portion allotted to us in life is strenuousness in the faithful performance of duty and in the fulfilment of our obligations. Recreation is only beneficial as it enables us with renewed energy and vigor to re-enter upon the performance of our duty in life. Especially fortunate is he who has for his superiors those with whom duty becomes a pleasure. I assure the members of the Western Gas Association that such has been our relation, that my serving you in the past years has been to me a great pleasure, and I am sure that in the forthcoming year it will be an equally pleasant task. Gentlemen, I thank you for this expression of your good will, and trust that I may fulfil every obligation expected of me. (Applause.)

MR. MCDONALD—The following is the result of the ballot: William A. Baehr has 59, D. R. Warmington, 32.

THE PRESIDENT—Gentlemen, Mr. Baehr is elected Second Vice-President of this Association for the ensuing year. Mr. Baehr, let us hear from you.

MR. BAEHR—Well, Mr. President, it seems I have to. Gentlemen, I will make the speech very short, because I might be accused of advertising St. Louis. I thank you.

MR. MCILHENNY—We cannot say what is the matter with the State of Missouri, as all three of our officers are now from that State.

MR. DOTY—You will have to show me.

THE PRESIDENT—The next office to be filled is that of Editor of the Wrinkle Department. Nominations are now in order.

MR. MITCHELL—I nominate Mr. Baehr.

MR. DOTY—I nominate Mr. McAdam, of Milwaukee.

THE PRESIDENT—Mr. McAdam is placed in nomination.

MR. BAEHR—I wish to nominate Mr. McAdam.

THE PRESIDENT—Mr. McAdam is nominated again. If there are no further nominations we will proceed to ballot for the Editor of the Wrinkle Department. Two names are in nomination, those of Mr. Baehr and Mr. McAdam.

MR. MCDONALD—Are we continuous tellers?

THE PRESIDENT—Yes; you are appointed indefinitely. While the tellers are counting the votes for the Editor of the Wrinkle Department, nominations for four Directors are in order.

MR. DOTY—Really five.

THE PRESIDENT—There will be nominations for five Directors; one to take the place of Mr. Baehr, who has been promoted, one for one year and four for two years.

MR. BAEHR—Mr. President, I wish to nominate a very able gentleman, who will undoubtedly do good work for the Association, Mr. Fred. Wheeler.

MR. DOTY—I would like to nominate Mr. Berkley, of Bloomington, Ill. Mr. Berkley has given evidence of his zeal for the welfare of the Association by his address to us this afternoon. I would also like to nominate Mr. J. H. Eustace, of Chicago; Mr. E. E. Witherby, of New York; Mr. Charles H. Dickey, of Baltimore.

MR. RAMSDELL—I would like to nominate Mr. George Clarke, of Kansas City.

MR. HOWARD—I nominate Mr. John D. McIlhenny.

MR. MCILHENNY—I respectfully decline. I have served for the past two years, and I believe in rotation in office, so I respectfully ask that my name be removed. I am very much obliged to you.

MR. RAMSDELL—I move that the nominations be closed.

MR. GEORGE CLARKE—I nominate Henry L. Doherty.

MR. STEINWEDELL—I move that the nominations be closed. (The motion was seconded and adopted.)

THE PRESIDENT—The nominees for Directors of this Association are Mr. F. B. Wheeler, Mr. Joseph Berkley, Mr. J. H. Eustace, Mr. E. E. Witherby, Mr. Charles H. Dickey, Mr. George Clarke and H. L. Doherty. As we have one Director to elect for the short term, some arrangement had better be made in advance for division.

MR. DOTY—The lowest man.

THE SECRETARY—I would suggest that the four recciving the largest number of votes be selected to serve for two years, and the person receiving the fifth largest number of votes be selected to serve for the short term. (The motion was seconded and adopted and a ballot was taken.)

MR. MCDONALD—I will announce the result of the ballot for Editor of the Wrinkle Department, as follows: Mr. McAdam, 48; Mr. Baehr, 31. For Directors: Mr. Eustace, 57; Mr. Dickey, 53; Mr. Wheeler, 50; Mr. Clarke, 47; Mr. Witherby, 42; Mr. Berkley, 36; Mr. Doherty, 31.

THE PRESIDENT—Gentlemen, according to the result of the ballot, Mr. McAdam is elected Editor of the Wrinkle Department for the ensuing year. Messrs. Eustace, Dickey, Wheeler and Clarke are elected Directors for the long term and Mr. Witherby a Director for the short term.

THE SECRETARY—Mr. President, it has been the custom in the Western Gas Association at the annual meeting of the Board of Directors for the past Presidents to meet with them. I believe that their experience and advice is valuable at the annual meetings of the Board of Directors. I therefore move that an additional section be made in our by-laws, making past Presidents of our Association *ex officio* members of the Board of Directors. (The motion was seconded.)

THE PRESIDENT—Gentlemen, you have heard the motion, which has been duly seconded, that past Presidents of this Association be made *ex officio* members of the Board of Directors. Mr. Secretary, that will require an amendment, will it not? (The motion was adopted.) There being no further business before the Association, we will stand adjourned until to-morrow morning at 10 o'clock.

THIRD DAY—MORNING SESSION.

The Convention reassembled on Friday, at 10:15 A. M., President Thwing presiding.

THE PRESIDENT—Is the Committee on President's Address ready to report?

MR. PRATT—Mr. President, in making this report gentlemen will notice that the Committee has refrained from saying all the

good things it could say concerning the President's Address, but has simply paid attention to the recommendations made.

REPORT OF COMMITTEE ON PRESIDENT'S ADDRESS.

The Western Gas Association—Gentlemen:

Your Committee to which the President's Address was referred begs to report as follows: Taking up the recommendations of the President in the order in which they are mentioned, your Committee does not agree with the opinion of the President that a central organization for directing the work of the existing Associations is more desirable than a merger of the Associations into one body; but does think that such central supervision of the work is better than the present system of disjointed working, and that in case the merger cannot be accomplished promptly such an organization would be of advantage and would probably pave the way to an ultimate merger. Your Committee does not consider that such a merger would annihilate or overthrow the older Associations, but would lead them into paths of greater usefulness.

Your Committee agrees with the President that a large part of the value of gas associations lies in the opportunities for personal interchange of thought, experiences and opinions afforded by the meetings, and thinks that this opportunity would be enlarged, and not restricted, by the merging of the existing Associations into one body. As has been stated by a prominent member of the gas fraternity, "With one Association it would be possible to secure such interchange with all other gas men, by attending one meeting only, while at present it is necessary to attend all the meetings to attain this end."

Regarding the recommendation for the formation of a gas institute it will be seen from what has been said before that your Committee favors a plan of this kind only as a second choice and does not think it well to proceed along the lines of a gas institute until there has been some definite outcome of the work of the Committee now considering the question of the amalgamation of the existing Associations.

Regarding the proposal of the Ohio Gas Light Association, your Committee feels, in view of its importance, that it be left to the deliberations of this Association.

Your Committee wishes to call especial attention to the President's remarks regarding municipal ownership, and recommends the appointment of a special committee of three by the President to investigate the best method of presenting the gas company's side of this question and the protection of their interests. Your Committee further believes that the formation of State Gas Associations will materially assist in bringing about better and more complete dissemination of information on this subject.

The Association is to be congratulated upon its exhibition in St. Louis last year, and its thanks are due to the members and others outside of the Association, who by their efforts secured its success.

All of the above is respectfully submitted by the Committee.

EDWARD G. PRATT,
ALFRED E. FORSTALL,
WM. E. STEINWEDELL,
Committee.

MR. DONALD MCDONALD—Has the report been acted upon?

THE PRESIDENT—I was just about to present the report to the Association.

MR. PRATT—I move the adoption of the report. (The motion was seconded.)

THE PRESIDENT—It is moved and seconded that the report be adopted.

MR. DONALD MCDONALD—I wish to say, on the part of the Ohio Gas Light Association, that the invitation which it extended to this Association had nothing behind it except good will for this Association as a body and friendship towards its members individually. The Ohio has no ulterior designs either on your persons or on your pocketbooks. The Ohio passed unanimously the resolution looking towards a joint meeting. You have no doubt all read it. I transmitted it to the officers of this Association in as courteous a letter as I knew how to write. The Committee on Next Place of Meeting has made its report; that report has been adopted, and I presume the matter is, therefore, finally disposed of. It is, of course, true that any gentlemen or body of gentlemen has the same right to decline an invitation that another has to issue one. The custom is that if it is declined it should be declined politely. If the Western is satisfied with the disposition

that has been made of this matter, I assure you that the Ohio is not offended. On the contrary, on behalf of the Ohio, I wish to invite every member of this Association to meet with us at Cincinnati next spring as our honored guests. Cincinnati is a town that has a greal deal to show of interest to gas men. If by that time Ohio has taken a name more in keeping with the national character of its membership and its aims, I want you to know that the invitation still holds good, and that you will meet with a hearty welcome. Now, gentlemen, as a member of the Western Gas Association, I want to indorse heartily all that this Committee has said in behalf of a single national association. Our efficiency should be equal to the sum of our combined powers, and not the difference, as it now is. There is not one of us that would tolerate in any enterprise which we controlled the waste of energy and the duplication of work which goes on every year in the gas industry in America owing to the present multiple system of associations. The State associations and the district associations have their proper place to fill—there are not too many of them; there ought to be more of them—but there ought to be one, and only one, national association. It should include in its ranks every man in the gas business that is worth knowing, and its work and its literature should cover every fact of any importance in the gas industry as it exists and is developed in America. Now, gentlemen, I have been told that this movement is premature, and by many others that it is impossible. Perhaps it is, but I don't believe it. The action which the Western has taken on the invitation of the Ohio is, to say the least of it, discouraging; but, if I can borrow the words of the Scotch poet, I want to say that I hope and believe that—

For a' that and a' that,
It's coming yet for a' that,
When gas men the country o'er
Shall brithers be for a' that. (Applause.)

THE PRESIDENT. I think it is hardly necessary to say that the latch string of the Western Association is always out, and that brother gas men of any association, or of no association, are welcome to all of our meetings and will be treated cordially and fraternally. If they want to become members of the Western we are glad to receive them; if they don't wish to become members

they are just as welcome as though they were members of the Association. So a definite and special invitation to members of the Ohio Association or any other Association to attend the meeting of the Western is not necessary. (The motion was adopted.) The report of the Committee embraces the appointment of a Committee on Publicity; I believe that would be the better word for it. That Committee will be appointed later.

MR. MCDONALD—I beg to report two additional members: Mr. F. C. Duncan, Galesburg, Ill., the Auditor and Treasurer of the Gas Company, to active membership; Mr. David Davis, of Litchfield, Ill., Secretary of the Litchfield Gas and Electric Company. That makes a total of 129 members that have been received by the Association at its present meeting. I move, Mr. Chairman, that the Secretary cast a ballot for these two gentlemen. (The motion was seconded and adopted.)

THE SECRETARY—I cast the unanimous vote of the members of the Western Gas Association assembled for David Davis, of Litchfield, Ill., and F. C. Duncan, Galesburg, Ill., for active members of this Association.

THE PRESIDENT—While it is not an order of business and is not included in the recommendations of the President's Address, it seems to me to be proper that a report should be made from this committee on the merger of gas associations, reporting progress or giving us some idea as to what is being done. I believe Mr. Doty is chairman as representing the Western Association.

MR. DOTY—What have you got before you now?

THE PRESIDENT—The report of the Committee on President's Address.

MR. DOTY—I did not hear it.

THE PRESIDENT—This has nothing to do with it at all, but we would like to have a report from our representatives to the committee appointed by the Gas Congress.

MR. DOTY—The president has requested that I report upon the matter that was brought up at the meeting last year at St. Louis, largely the question of better association work and how to accomplish better association work. As a result of a motion which was introduced at the meeting, the different gas associations throughout the United States, our own included, appointed members of a committee that were to consider this question of

better association work. This committee, consisting of representatives of the American Gas Light Association, the Western Gas Association, the Ohio Gas Light Association, the Pacific Coast Association, the New England Association, the Society of Gas Lighting, the Wisconsin Association and the Michigan Association, met in New York early in February. If I remember correctly, there were about 20 representative gas men present at this meeting. The discussion brought about a unanimous opinion that in order to accomplish better association work there should be presented some plan for closer affiliation, with the object in view of directing the work along better channels, harmonious work, avoiding working in parallel, so that there would be no overlapping. A vote was taken, and it was practically unanimous—I may say unanimous—that the sentiment was that there should be a better co-ordination, and a special committee of six was appointed to draft plans or prepare a report showing ways and means to bring about the accomplishment of the unanimous opinion of the men who were present. That sub-committee was to report back to the general committee, and if the plan received the approval of the general committee it was to be submitted to the Associations. I am not a member of that sub-committee, and, of course, I cannot speak for its work. I can simply say that as one of the general committee I have not yet received any notice of a plan to accomplish the object we had in mind. The sentiment which influenced all of the members of the general committee was to do something to advance the gas industry. The thought which was in my mind, and seemed to be in most of the men's minds there, was that at that meeting we could afford to sink our individuality as association men and stand out as gas men. Figures were presented showing the lamentable lack of financial support in carrying on the work that is possible, that should be done, to advance the gas industry. I think it was stated that the total revenues from all of the gas associations to-day, the small sum that they have at their command to carry on the work of investigation, is only about $12,000 a year. Figures were present showing the revenues of associations in allied industries. For instance, the Mechanical Engineers, the revenue is nearly $40,000 a year; Civil Engineers, the revenue is in excess of $40,000 a year; the Electrical Engineers have revenues in excess of $40,000 a year. Aside from these purely engineering societies, associations like the National Electric Light

Association had revenues in excess of $40,000 a year. Now these associations, with the means at their hands, can do much more effective work than a number of individual associations having total revenues of only $12,000 a year. One of the plans that was suggested was company membership. This is not a new idea; in fact, the older men of the American Gas Light Association will remember that at the organization the membership was a company membership. Representatives were selected by the companies to attend the meetings, but the revenues were derived from company membership. This plan commends itself, in the fact that the dues can be raised very materially by having company membership. The larger companies, like New York, Chicago, Philadelphia, St. Louis, Boston, could pay $100, $200, $300 a year for membership privileges in the National Association. A second class of membership would be the officers of the gas companies. You and I would be members of the National Association so long as we retained our identity with the Association. In the event that we lost our identity, we would then not retain active membership, the reason being that the control of the interests of the gas industry should remain with the men who were responsible for such work. In addition to the company membership and the active membership of gas company officers, there would be other classes of members, such as the professors in colleges. We could appeal to them and get the benefit of their work and investigation, which would add very materially to our information. The fees for membership of college professors and educators would naturally be small, because they would be giving to us a great deal more than we were taking from them. The meetings in New York lasted two days and were very harmonious, as meetings of gas men should be, having a common purpose in mind. I think they were earnest and sincere in their desire to do better work and accomplish better things. As I gathered from the meeting, there was no intent to destroy the individuality of the present associations. There is need for a gas association in New England. There is need for a gas association on the Pacific Coast. There is a great need for the State associations, and the class of work to be carried on by the State associations would be naturally local. They would carry on matters that properly came within their own province, such as taxes locally and legislative matters, and controlling of the market for residuals; but as far as the general investigations were concerned, those would be

outlined by the National Association, if there is to be a National Association, or a National Board of Control, if it is to be a National Board of Control, or whatever plan is adopted. The idea is not to obliterate any association; the idea is to harmonize the work of the association for the advancement of the gas industry. With that idea I am in hearty accord, and I trust that I voice the sentiment of the members of the Western Gas Association, and that as Mr. McDonald and I are the representatives, we can pledge the Western Gas Association to continue to give its full and real support to any plan that commends itself to our judgment, having in mind only the advancement of the work of the gas industry.

THE PRESIDENT—Gentlemen, I don't know but that it would be better to take some action in regard to this report. The committee was regularly appointed by motion.

MR. PRATT—Inasmuch as Mr. Doty's remarks have given the members of this Association a sort of a *resume* of the work of the committee to date, it would seem to me that some definite action would be proper at this time. I move that the remarks of Mr. Doty, as representing this Association, be made a part of the records, and if they are given by Mr. Doty as a report I move that they be received and spread upon the records.

THE PRESIDENT—I understand, Mr. Doty, that you make this as a report.

MR. DOTY—Yes, if you desire it. (The motion that the report be received and spread upon the records was seconded and adopted.)

THE PRESIDENT—The next order of business is Report and History of Western Gas Association's Exhibit at the World's Fair, by Mr. F. H. Shelton. Mr. Shelton being absent, Mr. Persons will read the report.

MR. PERSONS—Mr. Chairman and Gentlemen, this is the final report of the Committee of the Western Association on the World's Fair Exhibit.

FINAL REPORT OF COMMITTEE ON WORLD'S FAIR EXHIBIT.

PHILADELPHIA, PA., May 15th, 1905.

To the Directors of the Western Gas Association—Gentlemen:

In making final report upon the matter of World's Fair Exhibit it is unnecessary to write at length as to the causes which led to

the Exhibit, or what was done, as these points are covered in report made to you a year ago at the meeting in St. Louis, in June. Since that time the enterprise has been concluded and the remarks below are in the nature of comments upon what was done, together with a statement of costs and other matters necessary in closing the subject.

The general feeling that remains with me in looking back over the matter is that in spite of the trouble, the expense and the annoyances which necessarily accompanied such an exhibit, it was, nevertheless, well worth while, and to the continuing credit of the Western Gas Association, that stood forth and successfully put it through. The exhibit unquestionably served its specific purposes of forming a central meeting point for all gas visitors, of illustrating to gas men novelties and the best things in the business, and of showing to the public in a large measure the uses and conveniences of gas, in which we, as producers, and the public as users, are equally interested.

While it was to be regretted that our invitation to some of the other Associations to join in the movement, and thus secure a larger result, was not accepted, nor such plan carried out, and while as a result the standard for comparison or results were not as high as would otherwise have been the case, it is none the less a fact that the Exhibit was comprehensive in itself and successful and creditable, particularly when viewed as an Exhibit of one Association only, and not of the collective Associations of the United States.

In the beginning its usefulness perhaps appealed more especially to gas men who got there early in the season, and were especially interested in distinctive novelties, such as the DeBrouwer charging apparatus, inverted incandescent burners, improved meter appliances, etc., and of which these items are but a few of those shown, while in the latter part of the Exposition period its usefulness particularly turned towards that of the public interest, in view of enlargement of the display of burners, ranges, gas appliances for domestic use, etc. While it is often hard to trace the direct results and direct good which such exhibits accomplish, it is certain that both directly and indirectly much good is accomplished and the numerous instances in which reference has been made to the results of our Exhibit, fully satisfy me on this score.

It would be a pleasure to refer in detail to the co-operation almost unanimously displayed by the various exhibitors, but it is not feasible to take up each by name; even so, I cannot neglect this opportunity of pointing out that perhaps the largest measures of success was due to the particular co-operation of the Laclede Gas Light Company, the United Gas Improvement Company, representing gas companies without special trade interests, and the Welsbach Company, and the associated meter interests, particularly representing the trade.

The total subscriptions to the project amounted to $7,345; these came from gas companies chiefly in the Mississippi Valley, and the territory of the Western Association, and from trade interests and exhibitors, in about equal proportion. The total expenses amounted to $7,333.24, leaving a net balance of $11.76 on hand.

The above figures are after reckoning the subscription of this Association, and after paying all bills to date, of every description. There are no accounts outstanding. It is almost unnecessary to state, in this connection, but yet it is perhaps well to state so that it may be a matter of absolute record, as it is of fact, that all of the disbursements were made with close scrutiny, and with thorough fidelity in the expenditure of the collected funds; there were no extravagances, no salaries outside of the Representative in Charge and the helper, and no direction in which it might be urged that unnecessary expenses or personal comforts were paid out of the subscribed money.

The only outstanding point of any nature that is not disposed of is the following: In the beginning, it was promised that certain medals would be awarded those who exhibited and subscribed, and otherwise assisted the enterprise, as a recognition of their co-operation, and a pleasant souvenir. Later, upon a canvass being taken, it was found that the recipients-to-be preferred a certificate appropriate to the occasion, rather than a medal, as more easily framed or displayed. It has been the intention to distribute such certificates, but as the matter stands, the funds have been practically completely used in the construction, maintenance and dismantling. There is now no money available for this purpose. It is likely that by further canvass a little additional money could be collected, which would defray this expense, if it is still felt to be desirable. To a certain extent the Association is obligated, through its Committee, to distribute

these certificates; on the other hand, it might be that there being no funds, and a further canvass not being very desirable, the properly engrossed formal thanks of the Directors and of the members of the Association by suitable resolution would be accepted and be sufficient to those who may be yet expecting the certificates in question. In such event a suitable resolution, passed at this meeting could be quickly printed, in display type on heavy card to be signed by the Association officers and promptly distributed at almost no expense. I would like instructions on this point.

Mr. F. R. Persons, the representative in charge during the 7 months' period, as well as for 2 months thereafter, in the dismantling time, is entitled to the thanks and appreciation of the Association for his services and work extended in the Association's interests. He has made a short report from his point of view, and on the ground, which is herewith attached.

The detailed statement of all the moneys collected, and the itemized bills showing all disbursements, are completed and will be forwarded to the Secretary for file with the Association archives, and they will be open to the inspection of anyone interested.

I would suggest that the Committee be now discharged, the subject being virtually concluded. Respectfully.

F. H. SHELTON,
Committee on Exhibit, St. Louis Exposition.

ST. LOUIS, MO., Dec. 30, 1904.

Mr. F. H. Shelton, Chairman, Philadelphia, Pa.—My dear sir: The space in the Palace of Liberal Arts at the World's Fair that has been known as the "Gas Place" is no more. The exhibits have all been packed and shipped. We have tried to make the public understand that the gas industry is not a thing of the past, but a very live factor in the to-day and everyday commercial life. One cannot judge the benefits of the exhibition from a commercial standpoint, as we offered nothing for sale. The many inquiries made and interest taken in our exhibit by the general public lead the writer to believe that great good will result to every company connected with the gas business. The gas industry was represented by a very few people at the World's Fair, but those that were there managed to keep well to the front

in the business societies and social functions incident to such a fair. The several gas men who served on the international jury were made chairman of the group juries on which they served. We were represented on the superior jury by Mr. E. G. Cowdery, of St. Louis. Perhaps the most important work completed was the proper classifications of the various departments of the gas industry. The classifications that heretofore existed made no provision for anything connected with gas. To give an instance, "Gas burners" come under the head of "Lights not electric." This brought burners of all kinds in the same class as "Candles, Chinese lanterns," etc. The new classification places each department of the gas business under a proper heading, and future exhibitions will adopt the same. This work was accomplished through the efforts of group jury No. 48 assisted and aided by Mr. M. H. Hulbert, chief of the manufacturers and varied industry buildings. When the next exposition is held in this country the gas fraternity will be in line to take a proper place and have a separate building, where every branch of the industry can have an opportunity to properly display. The benefits of the exhibit will be lasting and far reaching. Personally I want to thank our exhibitors and contributors. During the entire time of the Fair I can remember of no unpleasant incident in connections with any exhibitor. Whatever the occasion I tried to do what in my judgment was best for the interests of the fraternity at large and that which would bring it most prominently before the public.

Thanking you personally for the appointment as representative of the Western Gas Association at the greatest of all World's Fairs, I remain, Yours very truly,

FRED. R. PERSONS.

MR. PERSONS—There is a point I would like to have the Association take up, and that is whether it is desirable to raise more money and present the certificates or take the will for the deed to a certain extent. It would probably cost $100 to put out the certificates. Or shall we let the matter drop with a suitable vote of thanks to the contributors and exhibitors?

MR. PRATT—Is it your desire to take the report of the Committee up in the form suggested? If so, I would like to make a motion.

THE PRESIDENT—Yes, we will take up the report in the regular way.

MR. PRATT—Our company contributed to the work of this Committee, and it also contributed so far as exhibitors are concerned. I feel that the Association ought to be congratulated, and it ought to congratulate the Committee, inasmuch as it was able to raise sufficient money to carry on this exhibition, and was able to pay its way. We should congratulate the Committee itself that it has been able to go through the thing and have a balance of eleven dollars and some odd cents on hand. As a contributor and an exhibitor I would say let the matter of the certificates drop, and let us congratulate ourselves, as I have said, that the exhibition was a success, and that it has taken care of itself financially, not to create any further burden or work upon the Committee by asking for proposed contributions. I therefore move that, so far as that part of the report is concerned, the matter of the certificates be dropped.

MR. RUNNER—I second the motion.

THE PRESIDENT—Gentlemen, you have heard the motion. Any further remarks? (The motion was adopted.) In that line I think it would be in order to present resolutions formally thanking the exhibitors of this Association, in line with the report of the Committee. Will you take that matter up Mr. Pratt?

MR. PRATT—I beg your pardon.

THE PRESIDENT—I think it would be proper to present a resolution extending the formal thanks of the Association to the exhibitors who took part in the exhibit of the Western Gas Association, in accordance with the recommendations that this Committee report. I would ask you to prepare those resolutions and present them.

MR. PRATT—All right. I will cheerfully move that some such resolutions shall be prepared.

THE PRESIDENT—Will you prepare a resolution and present it later?

MR. PRATT—Yes, sir.

MR. DOTY—Mr. President, may I suggest, in addition to the suggestion you have made, to extend our formal vote of thanks to the exhibitors, that it include the contributors, so that the contributors may feel that they are recompensed by the Association

formally for the financial interest that they have taken, and in addition to that, inasmuch as the Chairman of the Committee makes the recommendation, that the representative of the Western Gas Association throughout the entire exhibit be awarded a special vote of thanks. I have much pleasure in making a motion, if it is in order, and if it is not, the Secretary can get it in such shape that it will be proper, to tender to Mr. Persons, as the official representative of the Western Gas Association, a hearty vote of thanks and appreciation of his faithful, intelligent and conscientious effort for the good of the Association, and the members who were the guests of the Association, during the time of the World's Fair. (The motion of Mr. Doty was seconded and adopted.)

THE PRESIDENT—Mr. Persons, in the name of the Association I thank you for your attention to the exhibit of the Western Gas Association.

MR. PERSONS—Mr. President and Gentlemen, I thank you very much for this vote, and I assure you that the task was something that if I could have appreciated it—the 7 months were so long—I never would have dared to tackle it. To tackle affairs at the meeting, entertainment and that sort of thing, to last 2 or 3 days is very well, but spread it over 7 months and it is a pretty long task. I want to say, in connection with the report, that the report I made to Mr. Shelton will be printed with this report. I did not read it this morning, because it is not important at all. But Mr. Guldlin will take up the question of classification, which is perhaps the most important that occurred at the Fair. I thank you, gentlemen.

Mr. Pratt subsequently prepared the following resolution:

Resolved, That the thanks of this Association are due to exhibitors who participated in making the exhibit of gas apparatus and appliances at St. Louis during the period of the World's Fair in the year 1904 such a success; also to the companies and individuals who contributed to the fund for the preparation and support of this exhibition.

THE PRESIDENT—I will appoint as a committee on public information for the protection of gas interests, as recommended by the Committee on President's Address, Mr. James W. Dunbar, Mr. Fred. B. Wheeler, and Mr. J. C. D. Clark. We will now listen to a paper by Mr. George C. Hicks, Jr., on the

ROTARY BLOWERS AND EXHAUSTERS—CONSTRUCTION, EFFICIENCY AND APPLICATION.

In the early part of the 17th century, a man named Serviere designed a rotary pump having six lobes similar to the teeth of of a gear. This design is closer to the present type of machine than any other of the early efforts in rotary construction. During the 18th and first half of the 19th century, various forms of rotary pumps and engines were designed, quite a number of which were of the two and three lobe type; some of the intercepting blade type, such as the old Baker machine and some of the sliding vane type, such as the Makenzie.

I shall confine my paper to a rotary blower in which the impellers are symmetrical about two axes at right angles to each other and alike one to the other, the lobe of one passing through the throat or waist of the other. I find that in rotary machines the pump and engine antedated the blower, for the blower seems to have been an off-shoot of the other line of development.

In fact the Roots blower was itself directly responsible to an attempt to build a water motor by the Roots brothers, who at that time owned and operated in a woolen mill. This motor was intended to operate their mill, but being constructed of wood, it naturally swelled on being put to use. It was taken to the shop, the tight places relieved and then belted to a line shaft for test as to its running qualities. A foundryman standing close by noticed the current of air delivered by the machine and induced the Roots brothers to build them one for foundry purposes. It proved a success and was the foundation of the rotary blower and exhauster business of to-day, for with one or two exceptions the characteristics of the original Roots blower have been adopted as the best and simplest form of rotary machine to date. These characteristics are to impellers of identical form and symmetrical about two axes at right angles. The development has been very gradual and the changes those of mechanical detail and shop convenience and as improved machinery capable of more accurate work was placed on the market, slight changes in impeller forms have been made to take advantage of the chance to improve the efficiency by closer machine work. From a machine giving a fair efficiency at a pressure of 1 lb., we now have one that at 3 and 4 lbs., shows an efficiency equal to the best design of blowing engine and at a much less cost.

General Design—The general design of rotary blowers is much the same, different manufactures differ mainly, first: form of impeller; second, manner of mounting impeller on shaft; third, design of bearing.

The machines are made either horizontal or vertical, a horizontal machine being one that has the inlet at the bottom and the outlet at the top or the reverse; a vertical machine, the inlet and outlet at the side. The vertical type has some advantage of connecting piping, but the horizontal machine is stiffer and capable of running at higher speeds, which give better efficiency, as will be shown later. Either gears at one end or gears at both ends may be used. Single gears for pressures up to 1 lb. when used without outboard bearings and up to 10 or 12 lbs. when supplied with double outboard bearings. Double gears are used over the entire range of pressures and the choice is generally determined by the type and class of machine driving the blower.

Bearings for light pressures usually have only an up-and-down adjustment, but for machines from 2 lbs. up the quarter box is preferable, as additional strains have to be cared for that do not exist in the low pressure machines in sufficient force to demand protection from them.

Self oiling is almost universal on all styles of rotary blowers and may be either by chain or ring. Both find their advocates, but I believe the final result will be in favor of the ring, though there is little to be said against either method. The machines are generally made up of from 8 to 12 parts, as follows:

The head plates carrying the bearings.

Two half circles in which the impellers revolve.

Two impellers and shafts.

Two or four gears and gear cases for same.

Two pipe plates, discharge and suction.

One bed plate for direct connection to engine or motor.

The design of the individual parts must be such that there shall be no deflection in any part of the machine. The theory and construction both demand stiffness. The head plate must be so ribbed as not to bulge out under the pressure of the gas or air, or give at the bearings under the shaft pressure. The half circles must also be rigid under pressure and stiff enough to resist any tendency of the head plates to spring them. As head plate clearances are as low as 0.006 and case clearances as

low as 0.01, it will readily be seen that to keep a machine from pounding, the keynote of construction must be rigidity. So also the impellers, besides having a good shaft bearing at each end, must be ribbed inside and for pressures over 1 lb., supported by a longitudinal wall running from one shaft bearing to the other, forming virtually a box girder. This construction is absolutely necessary, for no matter how stiff the case, if the impellers themselves spring, the machine would soon give trouble. The shaft also should not give under the load.

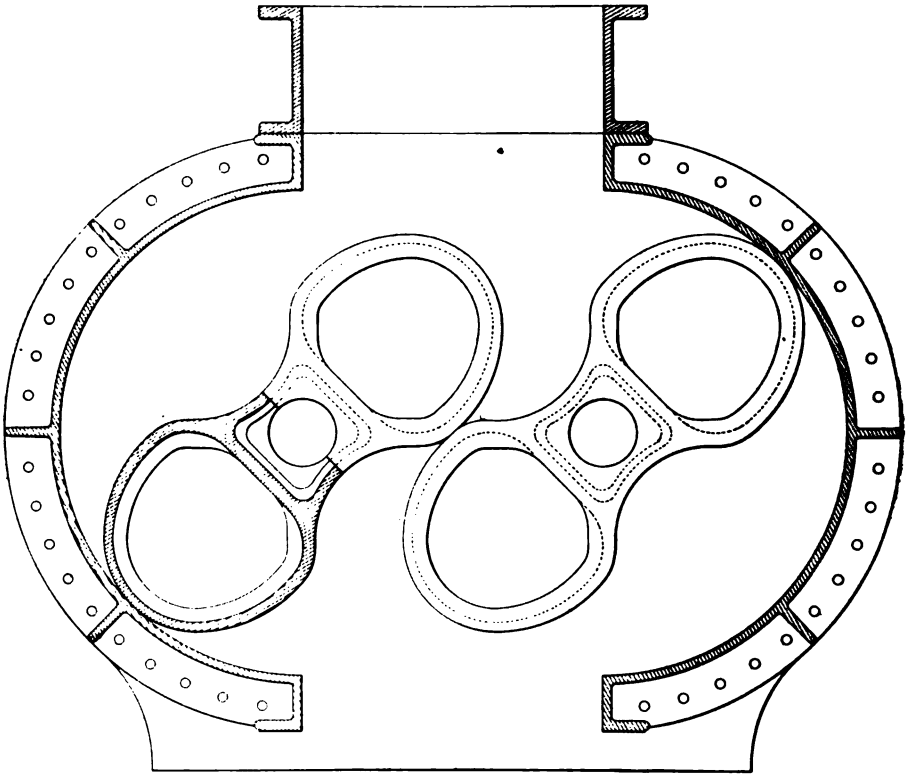
The proper relative position of the impellers being due to the accuracy of the gear cutting and setting, great care is necessary to have the gear square on the shaft, keyed or clamped without distortion and teeth cut so there shall be no irregularity. Two teeth should always be in contact. If more than two teeth are in contact, it means a finer pitch, which has a tendency to weaken the tooth. If less than two, there is a chance for back lash to take place. The width of face of gears on blowers is generally about three times that necessary for driving strength and is proportioned for wear, so that the adjustment of the impeller positions shall be necessary at long intervals only.

Impeller Curves—In taking up the subject of impeller curves, I want first to disabuse your minds of the idea that they have any necessary relation to the curves used in gear teeth. The object of the two is radically different, for gear teeth are for the purpose of transmitting power, while the last thing the blower manufacturer or owner desires to do is to transmit power from one impeller to the other.

The choice of a particular curve should be based on, first, the simplicity and accuracy with which it is laid out; second, ease of reproduction in shop; third, the amount of metal left at the waist of the impeller. Reason one insures accurate templets, which are absolutely necessary for good work and reason two insures accurate reproduction in the shop, for the less complex and more free from sudden changes of curvature, the easier the impeller is to machine and consequently the greater uniformity of the clearance between the two impellers when operated. Reason three covers structural strength and is subservient to the others, but is still a point to be considered in design.

The curve used for the impeller does not affect the leakage of air or gas at either the head plates or case circle. This leaves,

therefore, only the rolling together of the impellers at the center line to be considered. In gas exhausters handling foul gas, a sharp edge must be left at the extreme outer point of the impeller curve in order that the rotation of the impeller may scrape away the accumulation of tar on the case circle. This sharp edge necessitates in turn a break in the curve, which forms a clearance pocket and carries back into the suction a small amount of gas.



Continuous Contact Impeller Curve.

As foul gas is mostly handled under low pressures, this loss is very small. For high pressures, it would increase as the density of the gas increases. Usually high pressure gas is clean, so that an underbroken curve may be used, avoiding the loss. If, however, there is any chance of tar or other clogging material passing through the exhauster or blower, it is safer to use the cutting-edge type, even though a small loss occurs.

The closer the curve through the throat agrees with the curve of the end of the impeller passing through it, the less the slip, but too close a fit is liable to run on to another shoal, the danger of one impeller hammering the other.

Wear of the Gears.—Now, as to the wear of the gears; the shape of the curve governs the strain on the gear teeth, but only the driven impeller need be considered, for the impeller on the driving shaft does not effect the wear of the gears. If the moments of resistances be plotted on a circular base, it will be found that the resultant curve is an exact reproduction on a larger or smaller scale of the impeller curve itself. In jump contact impellers the curve becomes concentric for the angular movement taking place during the shift of contact from one side of the lobe to the other. In general, the resistance is inversely proportional to the distance of the center of the shaft to the point of contact. Therefore, the jump contact impeller is easier on the gears than a continuous one; as the maximum and minimum are nearer together, but as an extra width of face of the gear will cover this advantage, the increased efficiency of the continuous contact type outweighs the gain in gear life due to the other type of curve. At low pressure the break contact type is most used for both gas and air, as it is cheaper to machine and at the same time entails no appreciable loss. As stated above, an impeller having a curve that passes quickly through the waist of the other impeller answers all the gear requirements and at the same time is of the best form to retard slip.

Slip.—The slip in a rotary blower should vary as the square root of the pressure, speed being constant; and inversely as the speed, pressure constant; directly as the clearance; directly as the square root of the reciprocal of the specific gravity; directly as the square root of the ratio of the absolute temperatures.

Taking them up in order as above stated, the effect of pressure comes first. The slip varies according to the law of flow of air or gas through an orifice modified by a constant **C**. The opening between the case and impeller and the impellers themselves is long and narrow and on the ends more like a narrow passage between two flat surfaces. As the end clearance may be made very small, this cuts little figure, the principal source of loss being the clearance between the case and the impellers and between the two impellers. In the jump contact type, such as is

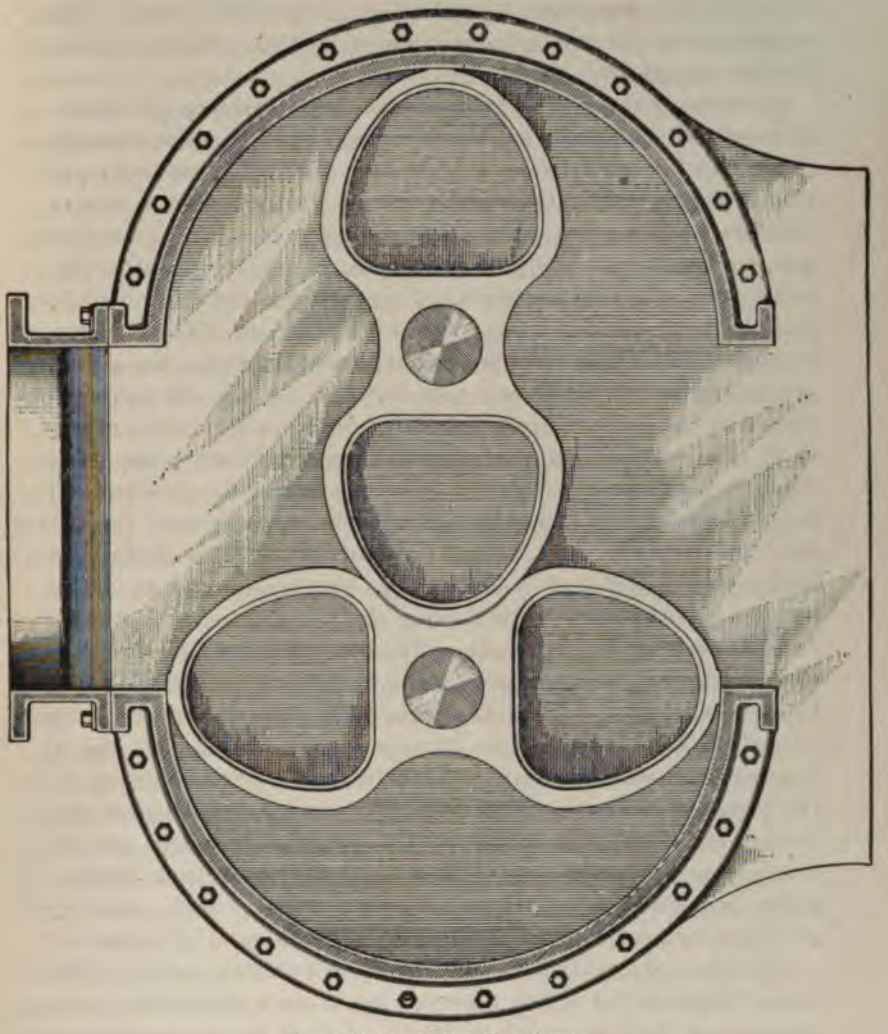
generally used for foul gas and low pressure, the clearance space cut away has little effect on the slip, but at high pressures, such as 5 lbs. (I used the term "high pressure" in a relative sense only as applied to rotary blowers), this clearance modifies the curve of slip so that the law of flow through an orifice does not apply. This can be seen in the pressure curves plotted for constant speeds. At low pressures the curve approximates closely the law, but for high pressure it is nearly a straight line. For continuous contact impellers, the law of flow through an orifice is very close to actual results.

Speed—The passing of larger volumes in a given time decreases the per cent of slip in inverse ratio as the revolutions per minute are increased. In addition, due probably to eddy currents set up by the rotation, the efficiency increases more rapidly than due to the speed ratio alone. Such a speed could be reached, however, where the velocity of the flow of gas would be so rapid that wire drawing would take place and the efficiency curve begin to fall, but as this point is beyond the safe speed of the blower, it is correct to say the efficiency increases with the speed.

Clearance—There is not much to be said on clearance; the slip varies directly as the square inches of opening. The clearance should, therefore, be kept down as low as consistent with safe operation. Small machines can be run on smaller clearance than large ones, but the loss in large ones is less because the proportion of volume to clearance openings increases rapidly. In fact, instead of being the ratio of the square inches of openings to the cubical contents, it is almost as the ratio of length to volume, for the different width of clearance spaces in small and large machines is very slight.

Specific Gravity—Specific gravity affects the slip directly as the square root of the reciprocal; therefore, gas at 0.5 specific gravity would give a slip 1.41 times as much as air under the same conditions. To illustrate, a machine showing 92 per cent efficiency with air at 3 lbs. pressure would show 88.8 per cent with gas at 0.5 specific gravity. The slip being 8 per cent with air, the ratio 1.41, the result of multiplying together gives 11.2 per cent slip, or 88.8 per cent efficiency, as above stated.

Temperature.—Temperature affects the slip slightly only, as it is proportional to the square root of the ratio of the absolute temperature. This must not be confused with the loss due to



Jump Contact Impeller Curve.

shrinkage, which is caused by the cooling down of the gas or air after being handled at high temperature.

Friction.—Friction must be taken as the sum of all losses other than slip. It covers the friction of the gears, bearings, stuffing boxes and impellers in the case. The latter in a machine in correct adjustment may be neglected. Stuffing box friction is dependent on the condition of the packing and may be large

or small, but when properly packed it is a very small item. The friction losses, therefore, narrow down to two principal ones—the bearings and the gears.

Considering the gears first, we find that the driving gear transmits just one-half the load, the other half being applied directly to the impeller mounted on the driving shaft. A well-cut spur gear, properly lubricated, will transmit its load with a loss of between 5 and 10 per cent. Taking 8 per cent as an average loss, we would have the gear friction equal to 4 per cent of the total load applied to the shaft. Allow, say, 2 per cent for the stuffing boxes and we have a total of 6 per cent. Now, as the friction of the whole machine seldom exceeds 10 per cent and is generally about 8, we have 2 per cent left for the friction consumed by the journals. In a top discharge machine, the driving shaft at the driving end is relieved of part of its load through the reaction of the gears, while the driven shaft has this thrust added to it. The bearings, therefore, should be proportioned for the total load on that shaft. In a bottom discharge machine, the load on the driven shaft is lessened by the pressure of the fluid handled and the load on the driving shaft is greatest as the gear reaction is down on that shaft, although it also is relieved of part of its load by the upward pressure of the gas or air. Care must be taken that the total upward pressure on the impellers does not exceed the total weight of the impellers, shafts and gears, for a floating shaft would be hard to keep in proper alignment, as all the thrust would come on the cap. An outboard bearing on the driving end divides the thrust of the gears on a single geared machine and thus reduces the wear and friction. In a double-geared machine the gear thrust is taken on both ends equally, provided each set of gears is doing an equal amount of work.

Efficiency.—In order to arrive at a correct understanding of the term "efficiency" it is first necessary to fix on a standard of performance or basis on which to figure. I shall use as a standard the horse power actually used for any given amount of free air delivered against any definite pressure, compared with the amount of power needed theoretically for the same conditions by the formula HP equals cubic feet displaced per minute multiplied by the pressure in pounds multiplied by 144 and divided by 33,000; or reducing the factor 144 divided by 33,000 to its decimal equivalent, displacement per minute times the pressure, in pounds

times 0.00436. This is virtually figuring the horse power on a square card, but as the adiabatic curve affects the power but slightly at low pressures, it is not necessary to consider it. For in comparing different types of machines, the only fair method of comparison is cubic feet of free air delivered per horse power used or applied to the shaft of the machine.

As a matter of fact, the discharge line of a rotary blower is a wave line closely approaching the adiabatic curve. This is caused by the release of a body of air or gas at suction pressure into the discharge side; the air already there compresses this additional quantity until the discharge pressure is reached, resulting in a momentary drop of pressure against which the machine is working and an immediate rise thereafter to discharge conditions. This compression is so rapid that it is practically adiabatic, the constant radiation of the machine surfaces reducing it towards an isothermal curve. As before stated, for low pressure these factors are merely interesting to note and not of sufficient importance to consider in estimating efficiency.

Losses due to slip are dependent on two principal factors, pressure and speed. The curves shown for constant speed and varying pressure cover a range of pressure from 22 ins. of water to 122.1 and a loss due to slip within the ranges of ordinary operation of from 30 per cent maximum to 1 per cent minimum.

In gas exhauster work, say at a maximum pressure of 22.5 ins. of water, the slip ranges from 1 per cent to 20 per cent for various speeds on an air basis. Modifying this for gas by multiplying by the square root of the reciprocal of the specific gravity or 1.41, the resultant loss is from 1.41 to 28 per cent or an average slip of 14.75 per cent for speeds ranging from 50 to 170 r. p. m.

For pumping clean gas, where it is possible to use a nearly constant speed, it is clearly advisable to select a machine to operate at its highest safe speed and thus get an efficiency of 81 per cent according to these tests, which were made on a machine not especially built for this service. Later results show an efficiency of 85 per cent under 5 lbs. pressure. The loss due to friction ranges from 1 per cent to 15.5 per cent and shows an average of about 7 per cent at 130 and 170 r. p. m. and 5.4 per cent at 110 r. p. m.; so it is safe to assume 7 per cent as an average friction load. This gives for gas-exhauster work an average efficiency of power applied to the shaft of 85.25 per cent times

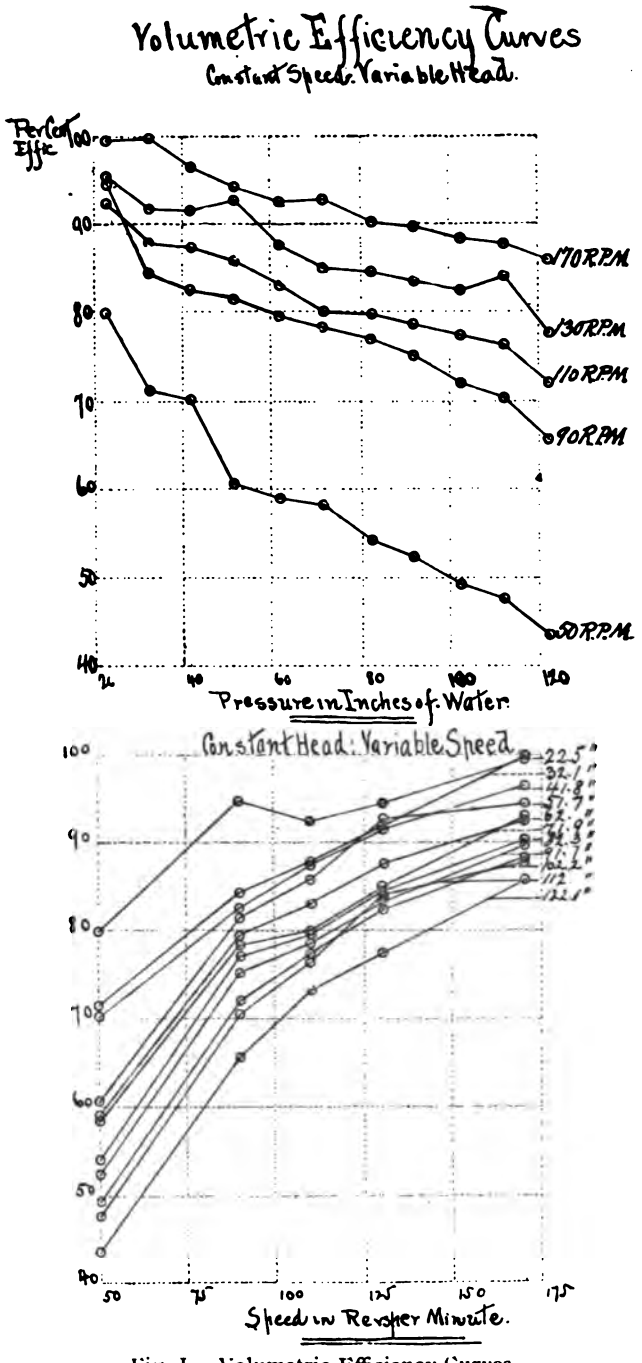


Fig. I. Volumetric Efficiency Curves.

93 per cent, or nearly 80 per cent as the useful effort of the power applied to the shaft. For high-pressure pumping, we have 81 per cent multiplied by 93 per cent, or 75.3 total and on a basis of 85 per cent volumetric efficiency, a total efficiency of 80 per cent. The loss due to temperature is not chargeable to the machine construction, as it is simply a shrinkage proposition and brings one to much the same set of formulas as those used in estimating condenser surfaces. Not considering the latent heat of the vapors, an approximate method is to consider the volumes as proportional to their absolute temperatures. The "American Gas Light Journal" of Nov. 4, 1901, page 730, contains a very valuable paper on this subject. The increased slip, as stated before, would be proportional to the square root of the ratio of the absolute temperature. Assuming a rise to 140 deg. from 60 deg., the slip would be multiplied by the ratio 1.07; thus 14 per cent slip times 1.07 equals about 15 per cent, or an increase of only 1 per cent due to a rise in temperature of 80 deg. The heat of compression also at 10 lbs. would raise air at 60 deg. up to 145 affecting the slip about the same amount, 1 per cent. The heating effect on the incoming air would be slight and I do not believe would result in an appreciable loss in volume delivered. The results stated before include all these losses and these points are brought up to show there is no need to consider these items as separate losses; at least at the comparatively low pressures used in rotary machines and as a matter of fact it is probable that the case expansion being less than the impeller expansion, the clearance is reduced and the slip decreased to some extent, probably enough to offset the additional slip due to the decrease in the density of the gas.

Type of Machines.—Taking up now the different styles of building rotary exhausters and blowers, we find two general classes, the vertical and horizontal types, which may be subdivided into single- and double-geared machines. For pressures up to 1.5 lbs. and comparatively low speeds, the vertical machine has equal utility with the horizontal type and has the advantage of lending itself readily to piping arrangements, including the by-pass. The horizontal machine is stiffer and can be run at from 25 to 40 per cent higher speed than the vertical machine, without undue vibration. The gear reactions form a limiting condition for speed in a vertical type. The case casting in the

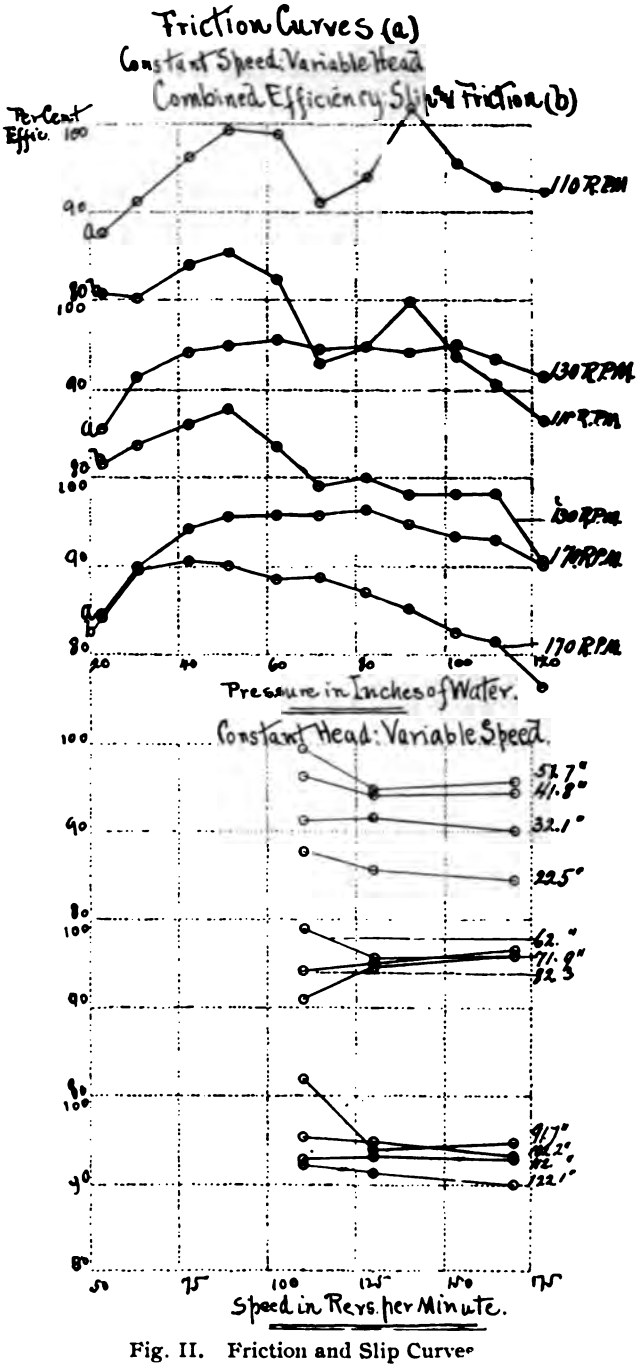


Fig. II. Friction and Slip Curves

horizontal machine is simpler, as no tar drip is necessary, the tar collecting at the elbow or T on the up-take to the machine. For exhauster work with foul gas, low pressures and speed, choose either type and no mistake is made, but for all other conditions, I am a strong advocate of the horizontal type.

Now as to machines geared at both ends, or only at the driving end. In favor of double gears, there are these points. More uniform wear on back and front bearing, less chance of accident from getting all the pressure on the end of one tooth, better opportunity for caring for back lash and in case of a tooth breaking ability to operate the machine with the gears at the opposite end. Objections: two additional moving parts to care for and oil, chance of throwing all the work on one pair of gears and of transmitting unnecessary strains through the driving shaft to the back gears. In favor of single gears, less complication, the concentration of all the wear at one point proportioned to take care of it. Objections: chance of crippling the machine entirely if a tooth in either gear should break and the tendency to wear front bearings more than the back ones, thus throwing the machine slightly out of line. Both styles have proved serviceable and durable for all classes of work and the choice should be made on specific arrangements, such as driving arrangements, space, etc. For low pressures, either type; for high pressures (say 2 lbs. and over), I prefer single gears with double outboard bearings. These outboard bearings stiffen the machine and divide the load of the gears onto two bearings, which makes it much easier to keep the shafts in accurate alignment. The double-gear arrangement, however, has been longest on the market and experience has proved its utility, but as the tendency is towards higher speeds and pressure, it is my conviction that the stiffness afforded by the single-geared machine with double outboard bearings is the better arrangement for such service. If it were only equally good, it would be better on account of its simplicity.

Method of Driving—The various methods of driving may be divided into three classes, belt or rope, pinion and gear, including the silent chains, and direct connection, either rigid or flexible coupling. The belt or rope may be dismissed with few words, as the losses inherent in belt transmission are well known and should not run over 3 per cent of the power transmitted and probably

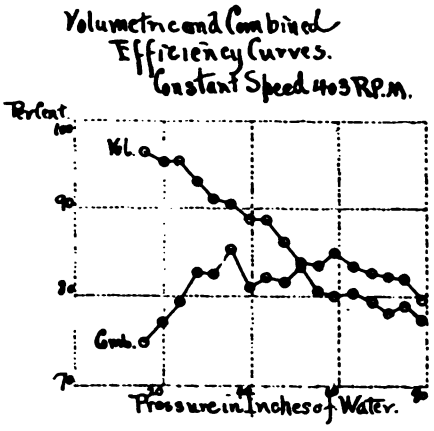


Fig. III. Efficiency Curves.

not under 2 per cent. Keep the speed of the belt preferably between 3,000 and 4,000 ft. per minute, the belt pull from 60 to 80 lbs. for double belt per inch of width. For light drives an overhung pulley is permissible. For 1.5 lbs. and up, use an

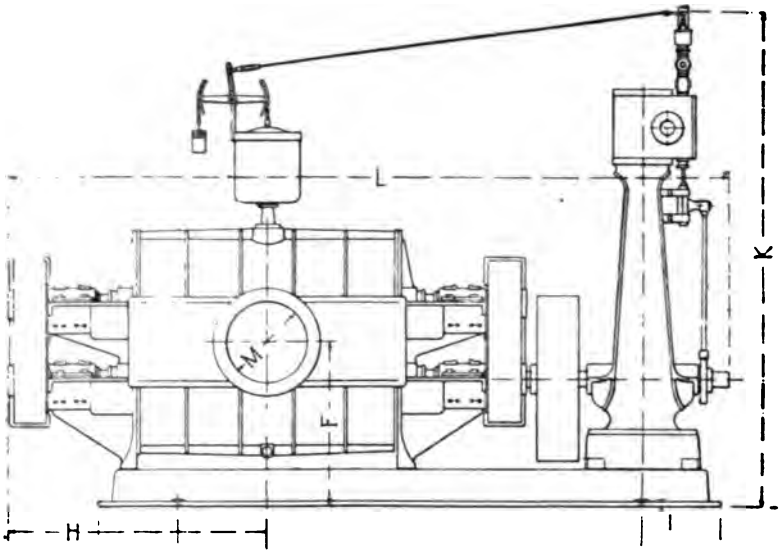


Fig. IV. Rigidly Coupled Exhauster.

outboard bearing. An outboard bearing is never amiss under any conditions of load, as it relieves the machine of strains which tend to wear the bearings and allow the impellers to get out of position. The same precautions apply to the silent chain drives and to the gear and pinion. Use outboard bearings for 1.5 lbs. and up and always consider them a good investment. The silent chain makers claim an efficiency of 98 and 99 per cent. Gear transmission runs from 60 to 95 per cent, according to the speed reduction and condition of the gear. Gears and silent chains are

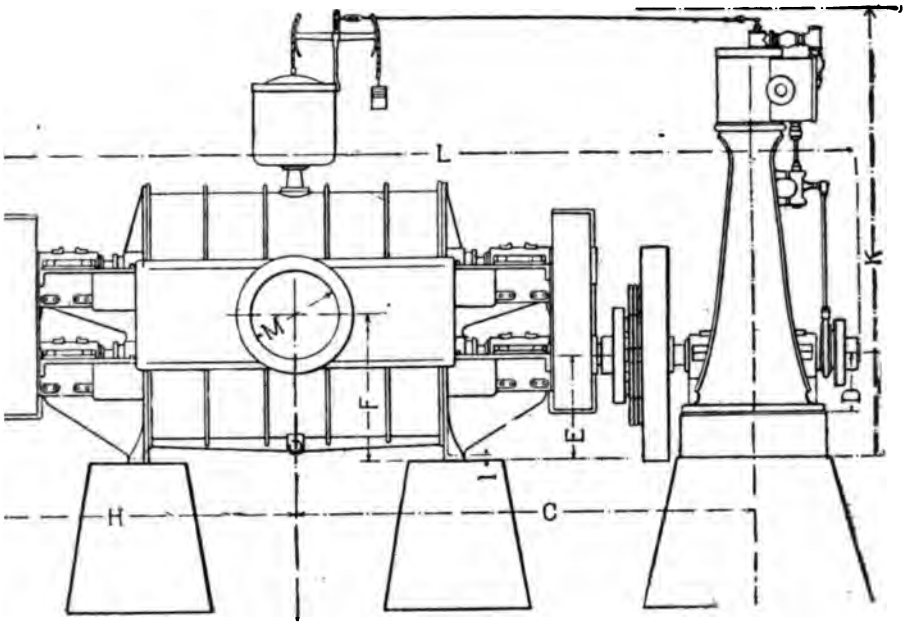


Fig. V. Exhauster with Flexible Coupling.

mostly used for motor drives, although gas-engine speeds are such as to frequently require speed reducing transmission. Hydraulic turbines may be geared or direct connected. Steam turbines have never yet been applied, as far as I know, to the rotary blower, the objection being the great change in speed necessary. However, I believe this objection could be overcome by the use of high-speed helical gears such as are used on the De Laval turbine. The larger percentage of blowers and exhausters are direct connected when driven by engines. The

line cuts presented herewith show the general methods in use. Fig. IV shows a rigid coupling, side or center crank engine, the fly wheel forming one-half the coupling. A center crank engine is best here as it relieves the exhauster bearing of the crank thrust. This style is well suited to small machines and light loads. Fig. V shows a center crank engine with flexible coupling, no outboard bearing, and gives no engine load on the exhauster or blower. It is a good construction for light or heavy loads and for engine sizes as large as an overhung fly wheel is desirable. Fig. VI is a horizontal side crank engine with outboard bearing and flexible coupling. This is, in my opinion, the best method of any of the others.

Each machine is self-contained and, therefore, each machine may be adjusted for wear or misalignment without reference to the other. All rigid connected machines are more or less dependent, one on the other. Few engines have vertical adjustments and all rotary machines must be adjusted vertically at times. The heating of an engine shaft tends to thrust the impellers against the back head plate, while wear tends to pull the impellers against the front head plate. Also, fly wheels have a tendency to assume a different position when running than idle and this fact sometimes necessitates a readjustment of the flexible coupling. Fig VII is a vertical engine and about the same in general arrangement as Fig. VI. Fig. VIII is a rigid coupling, single outboard bearing and engine, mounted on a bed plate. This was most commonly used in the past, although it is being gradually superseded of late by the introduction of flexible couplings, which do not need a bed plate. Fig. IX represents a single-geared, double outboard bearing machine and may be used with either center or side crank engine. In rigid connected outfits, the double outboard bearing may be used as the outboard bearing of the engine and the half coupling placed on the driving gear, or the engine may have its own outboard bearing and the coupling placed between the two outboard bearings of the respective machines. A flexible coupling can be used between the two outboard bearings with a side crank engine, but if used with a center crank engine the outboard bearing may be dispensed with. Bed plates should always be used under rigid connections; at least under the adjacent parts leading to the coupling. It is a very difficult matter to maintain rigid connections when the engine

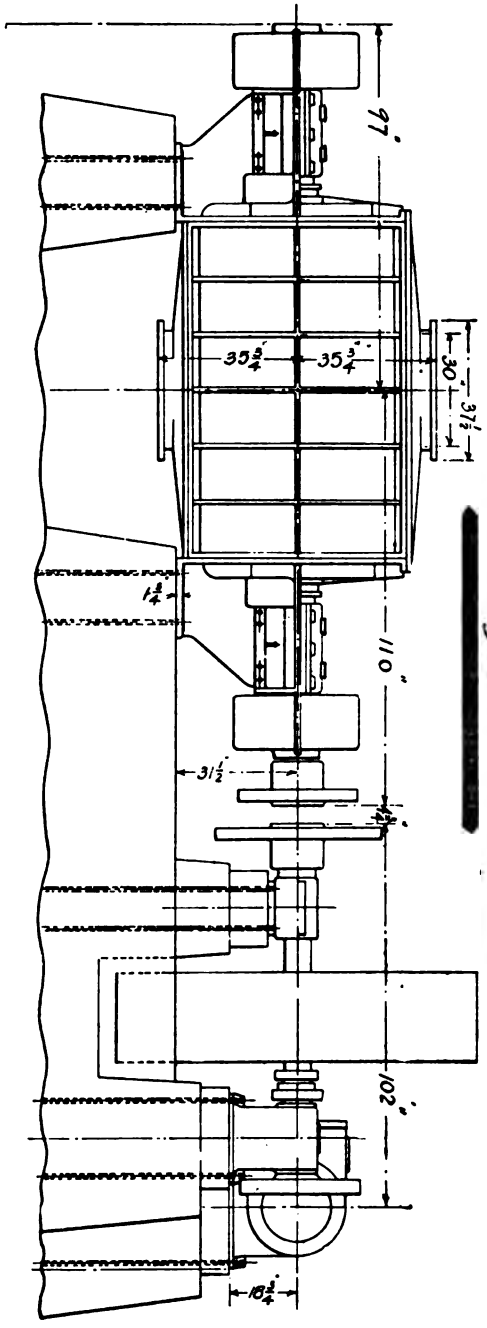


Fig. VI. Flexible Coupling.

and blower or exhauster are on a separate foundation and without a bedplate.

Speed and Pressure Control.—In gas exhauster work, uniform pressure must be maintained on the suction side and this may be accomplished by either a diaphragm or float governor. The float governor is more sensitive and gives much better results for this low-pressure work, which is usually under 7 ins. For control from the pressure side where great sensitiveness is unnecessary, the diaphragm works well and is simpler and more compact. The float governor can be applied to regulate motor speed by using a variable speed motor having field control through a rheostat. The shifting device for controlling the handle of the rheostat is more complicated than the steam governor on an engine, but can be made purely mechanical and not liable to get out of order.

For constant speed, throttling and automatic engines or other types of prime movers are well understood and need no description.

For water-gas exhausters, especially the larger sizes, the hand adjustment cut-off type is more economical than simply throttling down the steam. It is possible to control the valve travel, changing the cut-off by means of a float governor, actuating a small auxiliary valve, but the complication would hardly pay except for very large sizes. Unfortunately, the gas engine is not susceptible to variable speed control, except within very narrow limits and even then there would be irregularity owing to missed explosions and other troubles inherent in explosion engines. The development has been so great in gas engines, however, that we may hope. The gasoline engines on launches and automobiles are developing towards a machine of speed variation possibilities, but as stated before, the range must of necessity be limited.

Application and Losses Inherent.—The principal and most important use of an exhauster in a gas-works is the handling of foul gas either from the hydraulic main of the coal-gas benches or from a water-gas generator set. For handling coal-gas the exhauster may be placed at any point between the outlet of a primary condenser and the outlet of the secondary condenser. The preference seems to be for a position immediately after the primary condenser where the gas is handled at approximately 120 deg. The tar present at this point helps to fill the exhauster

clearances, but a lower temperature would be more favorable, for there would be less volume to handle and consequently less power used. As the total shrinkage may be as high as 30 per cent., it is readily seen that the machine capacity must be increased in proportion. The low pressures, however, make the power proposition rather unimportant. Another factor in favor of setting the exhauster close to the hydraulic main would be the governor action, which would be much surer and less fluctuating in such position. For water-gas no float governor or other automatic governing is necessary, either throttling or hand cut-off adjustment being sufficient. The same remark as to temperature and power would apply to water-gas service.

The losses for these two services are then, shrinkage, 25 to 3c per cent; slip, not over 10 per cent; friction, 7 per cent. As an example, suppose 60,000 cu. ft. an hour, at 70 deg. meter temperature, is to be handled. At 25 per cent shrinkage, this means 60,000 divided by 0.75, or 80,000 cu. ft., must pass through the exhauster. Now an exhauster efficiency of 90 per cent means a total of 88,888 cu. ft. to be handled by the exhauster. Say 1 lb. as the maximum total pressure, then the power required would equal 6.46 h. p. per minute; with 7 per cent friction this would mean 7 h. p. applied to the exhauster shaft, or about 7.5 i. h. p. in the engine. Usually we use 33.33 per cent as the loss to cover slip and shrinkage. This means adding 50 per cent of the amount of coal-gas as measured by the meter to obtain the total amount of displacement required in the exhauster. In the case above cited this would give 90,000 cu. ft. per hour as the total displacement. Figuring the power and adding 20 per cent to cover the friction of engine and blower, we get 7.7 i. h. p. as necessary, which checks very closely with the method stated previously and is somewhat less trouble to figure. The troubles in foul gas machines are mainly leaks due to the handling of hot foul gas which is full of penetrating oils and gases. For coal-gas machines, a by-pass from the suction to the discharge side is a good thing, as it makes it easier to shift from one machine to the other without risk of breaking any of the seals and also, when the make is very light, saves the engine by keeping up the compression in the steam cylinder. Without this compression the boxes on the connecting rod of both the crank and cross head end are soon pounded out of shape.

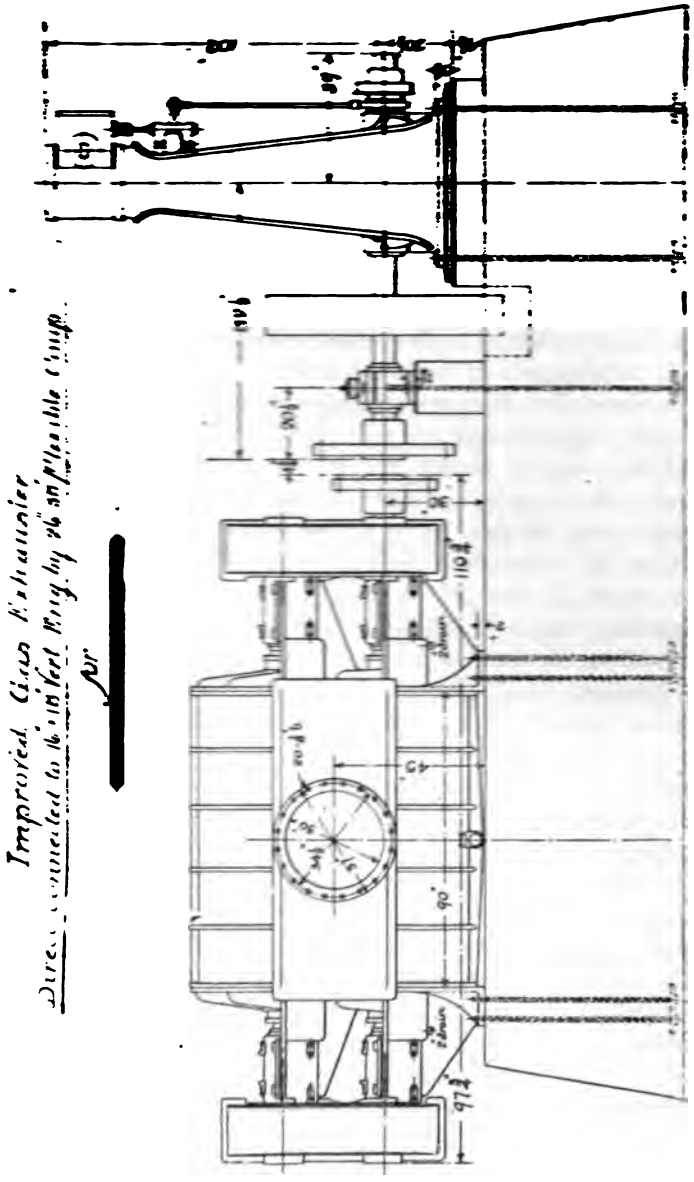


Fig. VII. Same as Fig. VI, but with Vertical Engine.

Next in importance is the pumping of clean gas from one holder to another or to a trunk line distribution or for long distance systems. The first service seldom requires over 4 lbs. discharge pressure and from 7 to 10 ins. water pressure at the suction side. The gas being clean, no tar trouble is experienced. The losses are slip due to clearance and pressure and the heat of compression. The latter may be neglected and the maximum

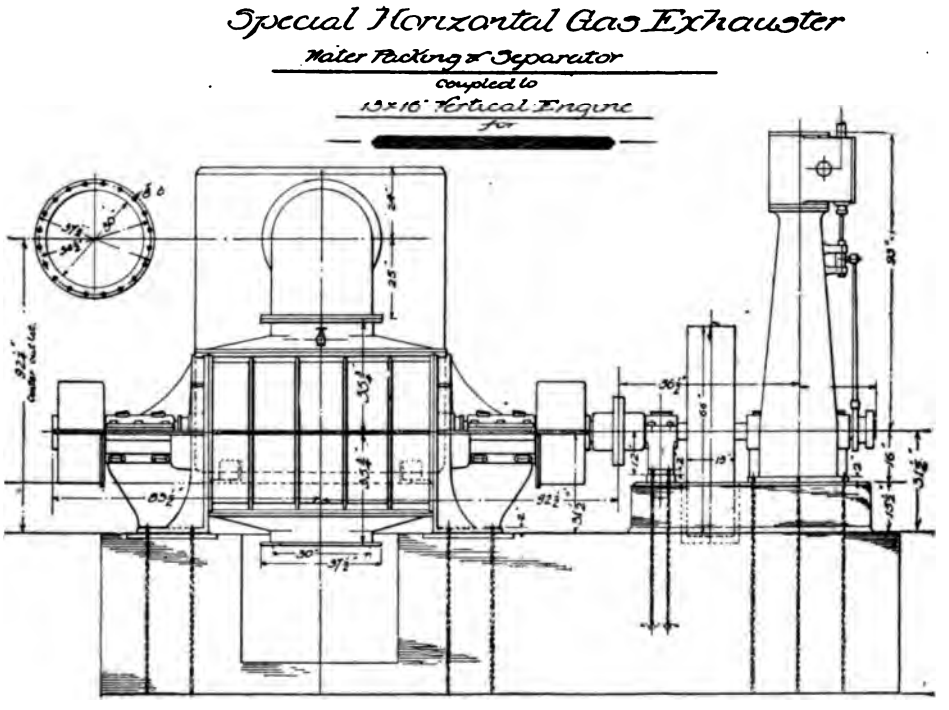


Fig. VIII. Rigid Coupling.

slip taken at 15 per cent; the friction at 8 per cent average. This service requires variable speeds and an engine or motor with hand adjustment for accomplishing this is necessary. Where the service is such as to admit of constant speed, gas, steam engines or motors may be used and at their best efficiency. The exhauster itself makes its best showing. At 5 lbs., for instance, 15 per cent slip and 8 per cent friction give an efficiency at the exhauster shaft of 78 per cent. For long-distance work 10,

or possibly 12 lbs. is the limit of the rotary machine, as far as commercial efficiency is concerned. Tandem machines offer a solution for higher pressures and promise efficiencies of 80 per cent for 12 or 15 lbs. The question of pressure for long-distance tranmission resolves itself into an equation in which the cost of installation, interest and depreciation on same are set opposite the operating expenses. I have used the word exhauster as covering all machines of the stuffing-box type handling gas.

Now let us consider the blower in its two uses for handling air around a gas-works. The first use is for passing a definite proportion of air into the purifying boxes. Second, the use on the water-gas set. The first application needs no comment beyond a word of precaution to use an outboard bearing with the blower. They are usually small, have light shafts and not able to withstand much belt strain without quickly wearing the boxes, thus pulling the impellers out of alignment. The second application is most important and interesting. The tendency towards higher pressures brings this work into the field of the rotary blower with special fitness. With 22 ins. of water it is not difficult to obtain 93 per cent volumetric efficiency and an efficiency at the shaft of 82 per cent or an average of 80 per cent for a variation of 25 per cent in speed. Here the blower should be controlled in speed by a pressure governor operating to change the steam supply of the engine or the current furnished to the motor. The power then used would be proportional to the output and maximum efficiency conditions would prevail. With a run in progress the blower would barely turn over, provided only one generator was used, but with two or more the idle periods would be shortened. For large installations the Corliss type lends itself well to control by a diaphragm governor, for a rod could be run from the same and connected to the knock-off blocks of the engine and the ball governor used simply as a safety device to prevent excessive speeds.

Another method would be to install an individual unit for each generator and at the end of each blow throw open a relief valve, which would cut down the power used during the run to friction load only. This friction load would not at the maximum amount to over 20 per cent of the power used during the blow. This method would require a constant speed engine or motor or a drive from a line shaft.

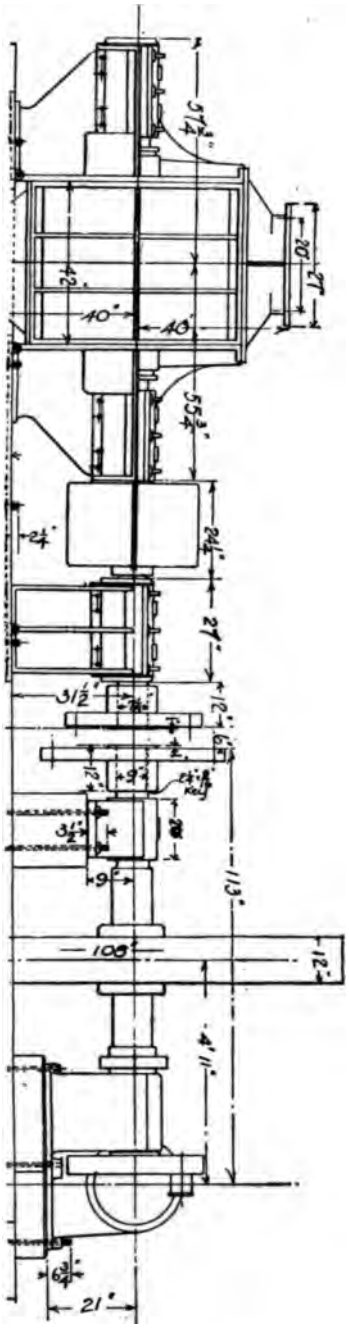


Fig. IX. Flexible Coupling Outboard Bearing Machine.

Construction of High-Pressure Machines.—With the increased demand for machines operating under pressures of 4 lbs. and over has come a closer study into the most efficient and durable design for this class of work. In order that close fits with small clearances may be used, the construction must be such as to secure great rigidity. This is best done by shortening the machine, thus reducing the length of the greatest leak opening, the contact between the impellers and also reducing the work of the gears, provided the same width of face is used. The question may be asked, why not use smaller gears with wider face? It is not good practice, however, to use too wide a face on a gear, as it is almost impossible to secure uniform contact with the whole tooth surface in wide-face gears. It is better to put more money into a machine with larger gears than into a machine of equivalent displacement, but of greater length and smaller gears, for it is much harder to maintain the same efficiency with a smaller machine, as the clearances must be made closer and the chances of trouble much increased.

Double outboard bearings should be part of all high-pressure specifications. I should say roughly that for air for pressures from 3 to 6 lbs. use a case length not over 2.25 gear diameters and a bore not over 1.65 gear diameters. The same machine for gas up to 4 lbs. For 6 to 10 lbs. of air, use 1.25 to 1.5 gear diameters and for gas use the same machine from pressure of 4 to 8 lbs. Some variations either way are allowable, but I am stating safe limits that have been proved by actual practice.

We cannot always build according to our best design for the commercial side is standing with uplifted club to knock in the head any attempt that means perfection. We must of necessity be a little short of our ideals; but always pushing the standard ahead and creeping forward with so slow a movement that the uplifted club never falls.

Methods of Testing.—There are three simple methods of testing rotary blowers, as follows: First, the closed discharge method; second, the stationary method, and third, the standard orifice method. There is still another method, which necessitates greater care and more apparatus and that is the use of the Pitot tube and, of course, actual meter or tank measurements. I shall explain the first three only, as the other methods are familiar to all of you.

The closed discharge method is to operate the machine at such speeds that the displacement is just equal to the slip. This is done by closing the discharge and rotating the machine at such speed as will just maintain the desired test pressure. This method is based on the theory that the slip is a constant quantity per minute, independent of the speed. This is not strictly true, as an investigation of the test data will show that the efficiency increases faster than the speed ratio. There is undoubtedly a point where the two curves cross and this point is near the normal operating speed of the machine, for there have been numerous checks to confirm this statement. For high-speed machines I believe the closed discharge method gives results too low.

The stationary method is to block the machine and pass air or gas back through it, the air or gas being measured by displacement of water either before or after passing through the machine.

Third, the standard orifice method is, in my opinion, the easiest to use and the most accurate, for after the standard orifice is once calibrated, a curve of flow for different pressures may be plotted. Any number of these orifices may be used with the precaution of spacing them equally around the central axis of a chamber that is also uniform about the same axis. They should, of course, be placed in a plane at right angles to this axis.

I have among my headings the care of machines and erecting troubles, but as Mr. E. D. Johnson presented a paper covering these points before the 1905 meeting of the Ohio Gas Light Association, I will not take up that subject here.

In closing I wish to state I have tried to give the information that will be of use to gas men using rotary blowers and exhausters or contemplating their purchase. If anything has been left out it is your province to name it. Many statements have been made here that are a matter of personal deduction, but they are based on observation, results of tests and information cheerfully given by your own members, to whom thanks are due.

I have also tried to cover the subject from a non-partisan point of view; but if there is any deviation from this path of rectitude, remember I was obliged to draw principally on the resources of my own business affiliations.

DISCUSSION.

THE PRESIDENT—Gentlemen, this paper is now open for discussion.

MR. BAEHR—Mr. President, I did not prepare any discussion on this paper, but I would not like to see such an able paper, and one which covers the subject so thoroughly, passed by without a good discussion. My experience with blowers and exhausters has been limited, but I will say that we have been studying the subject, and have made some experiments and some installations in St. Louis, which has helped to clear my ideas on these matters considerably. There are two points in Mr. Hicks' able paper which I wish to call to your attention. Mr. Hicks is a great deal better posted on this subject than I am, and he made one installation in St. Louis in which we direct connected a gas engine to a blower for 5-pound work. This direct connection was made against the advice of Mr. Hicks. I may say I did it largely on my own responsibility, in view of determining how much trouble would result. We put in a riveted coupling between two outboard bearings, one outboard bearing of the gas engine and one outboard bearing of the blower, and I must admit that for the first few months we had a great deal of trouble. The blower would heat first in one place and then in another, and a great many times we had to shut down so as to allow it to cool off. By putting a good mechanic on the job we subsequently got the machines lined properly, and from that moment our troubles have ceased. Mr. Hicks put this matter to me, I think, very concisely, when he asked if we would not prefer to have avoided that several months of trouble and condensation, and have put one or two hundred dollars more in the construction and have put in a flexible coupling. I wish to put the subject fully, because I am not a crank either way, neither is Mr. Hicks, I will say that. Now, there is one other point in connection with blowers that appeals to me. The use of these machines for distributing gas and helping out the low pressure districts on our systems is increasing, consequently our knowledge of these machines should increase. This paper is the best written information that I have seen on the subject, and it will help a great deal, and it should help everybody. In connection with 5-pound work, such as we have started in St. Louis, we at first took a machine which was fairly long for the gear diameter. Upon

further study of the subject we have lately bought a machine which is short in comparison with the gear diameter, and we have a stiffer machine and hope to get better results with it. This is in conformity to Mr. Hicks' recommendation in this paper. I wish to add my personal thanks to Mr. Hicks for the able exposition of this subject.

THE PRESIDENT—Any further remarks?

MR. DOTY—Mr. President, I notice in the classification of machines presented by Mr. Hicks that he uses the term the horizontal and vertical machines. But I understand in both cases, Mr. Hicks, that the machines have horizontal shafts. Is that correct?

MR. HICKS—The difference being that one is above the other in one case and side by side in the other.

MR. DOTY—Have you ever found in any of these machines as now built for horizontal shaft that there is a spring in the shaft, so that the center of the shaft is apt to rotate in a circle? The idea is simply this: I think I got the impression that there was a liability to have a spring in the shaft, and a rotary motion of the center of the shaft. If that be true, of course, the machine men do not have to get ideas from me, but why not take your shaft and put it vertically, as in the Curtis turbine, and then the shaft is a column, instead of having the shaft as a shaft liable to have the flexure or the bending, and the rotation of the center of the shaft in a circle. I am simply giving the idea for what it is worth; it may not be of any value at all. If you have shafts which are liable to have this rotation, then turn this shaft upside down and have a column. That is one advantage claimed for the Curtis turbine over the Parsons turbine. But I think there is a very serious criticism. Mr. Hicks says: "We cannot always build according to our best design, for the commercial side is standing with uplifted club to knock in the head any attempt that means perfection." Mr. Hicks perhaps is very careful in his language in saying "commercial side." If he had said engineering side, and by that put a reflection upon the engineers of gas companies, I would have taken very, very serious exception to it.

MR HICKS—One minute, Mr. Doty. That reflection is not in reference to the buying by the gas company at all. I don't want you to take it in that way.

MR. DOTY—I will let you down easy then, because I don't know of any "big stick" among the gas engineers. We have our own troubles with our directors; but so far as the gas engineers are concerned, they should, and they do so far as I know, buy the best design that commends itself to their experience. We do not and would not stand for any falling off in not helping you in building your best designs.

THE PRESIDENT—Any further remarks, gentlemen?

MR. DOTY—Would there be any objection, Mr. Hicks, to putting your shaft vertical instead of horizontal?

MR. HICKS—I was going to answer, if you are through. The objection would be the difficulty of keeping the machine away from the head plate at the bottom. It would be a very difficult matter to run that on a column and get good operation, and it would be much more difficult to get at and adjust, because the wear is due, not only to the weight of the impellers, but principally to the pressure against which it operates, and the spring of the shaft is never balanced on any rotary machine of this type, so that the object of turning it vertically would be obviated. It would not be there. If it was a balance blade, if the impeller was balanced on both sides, turning it vertically would get rid of the distortion due to weight, but there is always only one side of the impeller in action; therefore, you would accomplish nothing by making the shaft vertical beyond getting rid of the weight itself. Now, to explain what I mean in my statement in regard to the commercial side. I mean strictly the commercial side—that is, the price you can get for a machine. It is a well known thing in all trades, in all machine design, that you have to modify your best engineering inclinations sometimes to meet the market, and that is exactly what my remark meant, and nothing more.

MR. DOTY—Who makes the market, Mr. Hicks? The buyer or the seller?

MR. HICKS—Competition largely, Mr. Doty.

MR. DOTY—Competition between manufacturers?

MR. HICKS—Between manufacturers.

MR. DOTY—Not the market, then?

MR. HICKS—Well, yes. For instance, suppose there are two different classes of apparatus, turbines and engines. You have got to try and keep your cost down per unit of output that the machines will develop within reasonable limits, or else you can

not get your price. You cannot put anything on the market simply because it is good; it has got to meet the competition of other classes of apparatus.

MR. DOTY—Will you tell me, then, as long as you have mentioned turbines and engines, why the price of turbines is so high? A turbine can be built, you know, so that it can be sold, I think, for less money than a compound condensing Corliss engine, for instance, and yet the turbine manufacturers keep the price of their turbines up to practically the price of a compound condensing engine, so that the buyer has got to pay the price of the turbine if he wants a turbine.

MR. HICKS—Well, they save on the other end.

MR. DOTY—Who saves?

MR. HICKS—The manufacturer. He is saving on the other end of the electrical machine by the high speeds used, the less amount of copper. He is able to get a higher price for his machine. And then another thing that you have got to take into consideration is the amount of money spent and absorbed in the development of that machine.

MR. DOTY—I am very glad to hear that point. That is exactly the situation in the turbine market to-day, that the buyer of a turbine to-day is paying for the development expenses. Now, those development expenses may be 25 to 50 per cent. of the cost of a machine.

MR. HICKS—They undoubtedly are.

MR. DOTY—Well, now, if that is true in other branches of gas apparatus manufacture, I am very glad indeed to have that point brought out, so that these gentlemen who are buyers will know sometimes they are paying for development expenses. If you can use that to get the principles down to what would be the best engineering, eliminating the commercial side, why, I think this meeting has well paid its expenses. Incidently, I expect to buy a turbine pretty soon, and knowing there are development expenses included in the cost of the turbine I am going to make my expense at this meeting out of the turbine people.

MR. DONALD MCDONALD—I would like to ask Mr. Doty if the purchasers of turbines don't pay for the development expenses, who he thinks ought to pay for them.

THE PRESIDENT—Mr. Doty, are you prepared to answer that question?

MR. DOTY—The consumer always pays. There is no question about that. We are in the hands of our loving friends, and they are all getting rich.

THE PRESIDENT—Gentlemen, if there are no further remarks, a vote of thanks may properly be made.

MR. MITCHELL—I move, Mr. Chairman, that a vote of thanks be given to Mr. Hicks for his most valuable paper. (The motion was seconded and adopted.)

MR. DOTY—Just one moment, if I may interrupt. My attention has been called to the fact that there is an unexpended balance in the hands of the Chairman of the World's Fair Committee. With your permission I should like to move that the Chairman be instructed to spend the unexpended balance in preparing a testimonial to the representative of the Western Gas Association at St. Louis, Mr. Persons. The fund is sufficiently large to give Mr. Persons a good time, or to prepare a very handsomely engrossed and framed memorial.

MR. PERSONS—I want to assure you—I thought perhaps a motion would be necessary—

THE PRESIDENT—Mr. Persons, you are out of order.

MR. PERSONS—I suggested to Mr. Doty that the money be voted to go back to the Association. Of course, I am very much pleased with the line he has put out.

MR. DOTY— I get half.

THE PRESIDENT—Gentlemen, you have heard the motion. (The motion was adopted.) We will now listen to the experience of Mr. O. N. Guldlin as an exhibitor at the World's Fair.

EXPERIENCES AS AN EXHIBITOR AT THE WORLD'S FAIR.

As I understand the subject assigned to me, I am to present you my observations at the Universal Exposition in St. Louis, for the purpose of developing a more united action whenever the opportunity again arises, so as to attain the representation commensurate with the magnitude of the industry in which we are all directly interested.

I believe the work done collectively and individually at this Exposition will live. I also believe whenever the bugle sounds again, where a corporal's guard, simply raised and guarded our industry standard, a company will fall into line, fully equipped

and ready for action. The corporal guard did its best and learned a "big lot" and I can assure you the appreciation shown for its efforts repaid it manifold for the time given and expenditures made. A good deal, if not most of the work done, may count only in limited ways now, but it points the way for magnificent future accomplishments, if supported by that earnest appreciation and fraternity spirit which spurs one on to success. Our industry has this spirit in a more marked degree, I believe, than any other organization of business interests in the world. Let us carefully foster and guard it. Experience teaches that it is too easily destroyed, particularly so when individual organizations are merged into larger bodies, where the individual necessarily becomes a smaller unit of the whole.

The gas industry with its close organizations has heretofore concentrated its work, so to say, within itself. It is unique in this respect. In 1893 an earnest effort was made for a World's Fair representation, but conservatism prevailed and the attempt failed. With most of you I then felt that an excellent opportunity was lost; I now know it, that the failure was a serious mistake, and I take this opportunity to express my appreciation and sympathy to those who led. How different it would all have been to our industry and everyone of us who visited the St. Louis Exposition if they had succeeded in raising our standard in '93!

Everything of interest to us in our industry we read in our professional journals; everything of general, and I may say of special interest in all other engineering branches the people can read about in popular articles in standard magazines. Have not a good many of you, when dropping in on one of your prominent business friends (as he is lighting a Welsbach and placing a chair for you before the gas grate), been asked if the gas industry is really advancing? He has read and heard of the enormous electrical undertakings and their multiplicity of application and appliances; the use of exhaust steam for distribution of heat, etc., all of which he assumes is heavily cutting into the former "gas monopoly." Would there be the opportunity for filling the press with all kinds of ridiculous articles that frequently appear, in which the public is seriously assured and the public believes that our product can be made and delivered profitably at a fraction of what is charged, if we would take advantage of the broad educational opportunities presented by our concerted action at such

expositions as that just closed in St. Louis; and we created and fostered through our Associations a department of publicity which by popular articles in standard magazines would present facts to the public such as are constantly appearing on accomplishments in other engineering branches. The time of mystery has passed. I believe it only proper that manufacturers in our line should contribute to the education of the general public by making exhibits, and in such exhibits strive for the highest possible award. I believe the manufacturers in our industry would gladly do this if they felt assured their product would be judged by men selected from our industry as competent to judge.

I also believe it not only proper but profitable in the broadest sense for gas companies to individually or unitedly, through our Association, take advantage of opportunities offered by such expositions for the general education of the public in the essential features of our industry. I speak from my St. Louis experience. The public is interested and wants to know, not only how to use but how gas is made. It is to a gas company's interest not only to have stockholders using its product but stockholders who know, besides when dividend dates are due, also how the product is made and treated which produces the dividends. It would surprise you to know how many visitors we had at St. Louis, familiar with the dividend feature, who spent considerable time and made repeated visits to our exhibit to be informed about the apparatus, showing a desire to investigate and learn. I presume they did not care to bother their Manager or Superintendent with what they presumed were a lot of foolish questions, or possiby they did not care for the gas works atmosphere incident to personal inspection.

Now let us consider the gas industry as represented at the Universal Exposition at St. Louis. It was only after tedious correspondence referred from one department to another, none evidently able to determine where such exhibit belonged, the first complete exhibit of gas works apparatus ever undertaken was finally provided space in the Manufacturers' Building. Other exhibitors in our line had similar experience.

Taking the exhibits of our industry as a whole, were they commendable? Yes. Creditable? I must say no, not for an industry representing an investment of over $1,200,000,000 earnings from gas sales and sales of residual products by census

report over $100,000,000 annually, and with manufacturers especially equipped for the industry called on to furnish apparatus and equipment estimated at $20,000,000 per annum to provide for the increases and development in the industry.

You have received the report of our Association Exhibit, in the Palace of Liberal Arts, the first exhibit of its kind ever made; we are, and should be proud of it; and that our Association blazed the way.

The general conditions and results have been stated in the report, but if you all realized the quiet, self-sacrificing work done, both directly and indirectly by those of your members, in whose care the organization and maintenance of that exhibit was placed, you would feel still stronger the meaning of the fraternity spirit in the Western Gas Association. It contributed magnificently to work out that exhibit.

The installation of exhibits at this, as at previous Expositions, was governed by an official classification, inherited and enlarged to suit, in the judgment of the officials, all the industries expected to be represented. This official classification embraces 144 groups sub-divided into 807 classes, and not only governed the location of exhibits by departments, but also the final judgment for awards by the International Jury selected. Naturally in the preparation of a classification of such importance and such magnitude, embracing all the industries of the world, careful consideration was given each industry as previously represented at International and other Expositions and group divisions were made, as found necessary or proper to represent the development of each industry in the general group classifications, each group again sub-divided into classes, as prompted by modern developments and the specializing of individual branches of an industry.

Each exhibitor was entitled to a jury judgment for a diploma of merit in his exhibit, in accordance with the group classification. The magnitude of an industry, it follows, was designated by the number of groups into which it was found proper to divide it, based on its previous representation at International or Universal Expositions and the subsequent developments in such industry brought to the attention of the Official Committee *by organizations or individuals interested*, recommending additional group division, again divided into a number of classes. The efficient work of foreign exhibitors and their close organization

in this respect was a revelation to American exhibitors. The diploma of award specified the exhibit's class or classes embraced in such group, but only one diploma of merit was given for each group, regardless of the number of classes in such group, embraced by the exhibit.

No fault whatever can be found with this system if proper group classifications were provided for an industry to clearly define its diversified branches under our modern industrial development of specialization. To illustrate: An exhibit of horses, jacks and mules could receive one award only; but if an exhibitor made a general exhibit of domestic farm animals, embracing a horse, cow, sheep, goat and pig, he was entitled to a diploma of merit for each—the group classification so provides. The manufacturer of a dynamo could receive his gold medal, so also the manufacturer of arc lamps. If one firm manufactured both and exhibited both, he could receive both awards and he justly should, each of the industries being of sufficient importance to cover an independent group with its class sub-divisions. This is more forcibly illustrated, for example, by the consolidated manufacturing enterprises embraced by such firms as the Westinghouse, who received 12 grand prizes, 8 gold medals, 4 silver medals and 1 bronze medal. I merely happened to note this firm's awards and use it as an illustration.

Now let us see the official recognition and consideration given the gas industry in the official classification prepared for this, the greatest Exposition ever undertaken. As I stated before, the group and class divisions were developed from previous exhibits, records revised and amplified by a special committee, prepared to deal fairly with the world's industries, and necessary so to secure a universal representation of exhibits by providing fair opportunities for awards to such exhibits.

In the general index of the classification, the word "gas" does not appear, nor the name of any process or apparatus embraced in gas engineering; equally conspicuous by their absence are our trade words in any of the headings of the 144 groups of classifications. The gas industry which has passed its centennial and could look with the dignity of age and development on almost all of the diversified industries represented; an absolute necessity, so to say, in every household and aggressively finding and capturing new applications, industrial and domestic, and which for

magnitude of investment is in the front ranks of the world's industries, had in some way been entirely overlooked. No, not entirely; on closer reading of entire text of the classification, "gas meters," "incandescent gas burners" do appear in the text, besides which I find the word "gas" mentioned 5 times, but only incidently in connection with petroleum, electric and "hot air" appliances. The rest of our industry was broadly covered under group No. 49—"Appliances and Methods not Electrical, for Lighting"—which group also embraces Japanese and Chinese lanterns, matches, acetylene generators, lamps, lamp chimneys, wicks and "smoke consumers." But for this broad and convenient group, no exhibit in the gas manufacturing industry in which we are concerned, could have been made for any definite or even general award. Now compare this with the group classifications provided for the textile industry, which embraced 11 distinct groups, sub-divided into 82 classes and for the judging of which 4 juries of approximately 18 members each were selected. Consider this with the absence of any recognition in the classification of our industry among the industries of the world expected to be represented at this World's Congress of industries.

As I stated before, how different it would all have been, first, if the attempt made in '93 had been successful; and second, if such success had been followed up with proper representations by our Gas Associations and individual manufacturers at the time of preparing the classifications.

I also submit for your consideration the result and effect which could have been produced by the exhibits made in our industry if the exhibits had all been collected systematically in one department, as would naturally been the case if proper classification had been provided. Compared, however, with the fearfully scattered individual exhibits made at the Paris Exposition, we have reason to congratulate ourselves, we did accomplish a decided improvement.

Immediately after the opening of the Exposition, exhibitors in our industry all realized the unfavorable conditions under which we were placed and immediately combined to improve the condition as much as possible; we particularly concentrated our efforts to secure an acknowledgment from the Exposition officials, that the classification under which our exhibits were installed was entirely

unfair for proper awards, and that unless some immediate steps were taken, in all probability our exhibit would be judged by men selected for their fitness in the industrial branches, forming the main portion of the groups under which we appeared. By persistent work the chief of the department admitted the necessity for a modification in the classification if such could be obtained, but it was intimated that such modification might have to be taken to Congress to become official. We were finally assured, however, that the matter would be referred to the International Jury when selected, for such action as they thought proper. Our efforts then became concentrated on at least securing a jury of of experts to pass judgment on our several exhibits. The courtesy was extended by the different departments to all exhibitors, to suggest names from which to select the International Jurors. We promptly joined hands and prepared a list; also communicated with the parties, urging them to accept appointment if tendered by the Exposition officials, who had at last by persistence been made to appreciate fully the conditions of our position. We were gratified to finally learn that from the list carefully prepared and presented, six men had been selected, representative men of our industry in whom we had the utmost confidence and that they would be assigned to judge the exhibits in the gas industry. Final organization resulted in five forming the American representatives of Group Jury No. 49 of Jury No. 2. Palace of Manufacturers, namely: Messrs. O. O. Thwing, Paul Doty, W. A. Baehr, Thomas D. Miller and J. M. Morehead, and one on Group Jury No. 26, Palace of Liberal Arts covering the Western Gas Association Exhibit—Mr. E. G. Cowdery. They all deserve our sincere thanks for the earnest and conscientious manner in which they discharged the duty assigned them and which appreciation of their work was shared by their co-laborers on the respective juries. The "gas man" was in and everybody knew it—every exhibitor in our industry felt the entering wedge had been driven in hard and the recognition of our industry will follow.

We had previously prepared and presented to the Chief of the Department a complete classification of gas industry, and finally, after considerable negotiation and modifications so as to cover actual exhibit made, were assured, as previously stated, it would be submitted to the jury when selected for such action as they

ircumstances. I submit for your
classification originally presented
odified and reduced list subsequently
closely to exhibits actually made, as
assification more broadly covers the gas
Several of the classes in the original it
dged by a liberal interpretation of classes
so were eliminated to minimize objections;
should in the future be covered by definite
raced in the gas industry groups instead of
ndefinitely referred among petroleum and hot air
ged, no doubt, by experts selected as jurors in
but hardly prepared to give much weight or value
made in our industry.

TUS AND PROCESS FOR THE MANUFACTURE, PURIFICATION AND DISTRIBUTION OF GAS FOR FUEL AND LIGHT AND RECOVERY OF BY-PRODUCTS.

roup . . . Retort Benches and Processes for Carbonizing Coal:

Class . . . Retorts, retort settings and furnaces.

Class . . . Tying gears for retort benches.

Class . . . Hydraulic mains, including tar and ammonia separating apparatus.

Class . . . Retort mouthpieces, bridge pipes and standpipes.

Class . . . Tools for operating retort benches.

Group . . . Method and Apparatus for Cooling and Condensing Coal Gas and Recovery of By-Products:

Class . . . Gas exhausters, pumps and compressors.

Class . . . Condensers of special design and arrangement.

Class . . . Tar extractors.

Class . . . Ammonia washers.

Class . . . Tower and rotary scrubbers.

Group . . . By-Product Apparatus:

Class . . . Tar stills and apparatus for treatment of tar products.

Class . . . Ammonia concentrating apparatus for treatment of ammoniacal liquor from gas works.

Class . . . Tools, appliances and fixtures used in the manufacture of coal gas and treatment of by-products.

Group....Apparatus and Processes Used for the Manufacture of Carburetted Water Gas.

Class....Generating apparatus with power operated devices for manipulation of valves and charging of fuel.

Class....Special appliances for blast and steam supply.

Class....Tar extractors and washers.

Class....Tools and appliances used in the manufacture of water gas.

Group....Purifying System and Apparatus for the Purification of Coal and Water Gas.

Class....Purifiers and apparatus.

Class....Trays or grids.

Class....Purifying material.

Class....Operating valves for purifiers.

Class....Testing apparatus.

Group....Analytical and Testing Apparatus for Gas Works:

Class....Apparatus for coal and coke analysis.

Class....Apparatus for gas analysis.

Class....Apparatus for by-products analysis.

Class....Photometers, calorimeters, pyrometers, thermometers and gauges.

Group....Gas Holders and Storage Systems and Apparatus for Gas.

Group....Gas Pressure Governor and Regulators.

Group....Valves, Pipe Fittings and Pipe for Gas.

Group....Tools for Gas Work, Street Mains and Services.

Group....Incandescent Gas Lamps, Burners and Appliances for Gas Lighting.

Group....Meters and Measuring Apparatus.

Group....Fuel Appliances for Gas:

Class....For cooking by gas.

Class....Heating and industrial appliances.

Class....For water and heating by gas.

Our exhibitors of gas stoves and heaters had some very unique and amusing experiences with the jury, no doubt experts on coal ranges, stoves, house furnaces, etc., under which group such exhibits were accepted. Their experience might have proved more serious than amusing but for the fortunate and opportune stepping in by Group Jury No. 49 and looking after our exhibitors' interests in the jury.

The general awards made by Group Jury No. 49, as well as individual awards under additional classification submitted, were promptly approved by Jury No. 2, but the individual awards were opposed when reaching the Department Jury, which recommended adversely on the additional groups at such a late date. An appeal was then presented in detail before the Superior Jury, who acknowledged the justice of the awards which finally were carried, but only after securing the co-operation of the chiefs of the different departments were the awards, as recommended by Group Jury No. 49, issued and made part of the official records by resolution finally adopted.

I present these recommendations and the classifications to you for such action as you may deem proper. You have here the jurors that acted in the matter, and they can probably tell you more than I can on that line.

DISCUSSION.

THE PRESIDENT—Gentlemen, this paper is before you for discussion. In connection with it, I wish to say Mr. Guldlin certainly did hard and efficient work for recognition of the gas industry before the World's Fair at St. Louis last year, and he is entitled to a great deal of credit for his efforts in that direction.

MR. MILLER—Mr. President, I don't see that there is anything I can add to what Mr. Guldlin has said. He certainly exhibited yeoman zeal in the work there, and as a matter of fact he was the chief pilot of all the operations there in regard to the gas business. Is that right?

MR. GULDLIN—Oh, no.

MR. MILLER—The situation was very frequently, as he said, amusing. I happened to be around the exhibit when the jury that was going to judge gas meters came along. Mr. Persons found they were very much interested in knowing how a gas meter worked, and being the representative of the exhibitors there he was very glad indeed to find some one to inform them that was not interested in the exhibit. I happened to be along about that time, and one particular thing that I recollect was that they never had heard of the recording or slot meter. Its features were pointed out to them. They were very much pleased with that and immediately awarded it a medal. It deserved it

all right, but it gives you some accurate idea as to the methods of classification, which renders it practically important for the jurors to be men who are posted in the particular line. I believe that this particular jury that I referred to were judging them at the same time they were large water meters, and they were all water works men on that jury, there was not one that pretended to know anything about the gas business at all. They could read a gas meter, I guess, and that is about all. Mr. President, I had intended, and I overlooked it, to bring up this subject before. At the meeting of the American Gas Light Association, in October, by request, I presented practically this same subject to the American Gas Light Association, and they heartily indorsed all of the ideas that Mr. Guldlin has set out here, and it was done just at a time when we wanted action of that kind to influence the international jury, the superior jury, in their final decision, and I have no doubt it had some influence in that final decision. The subject was not as fully discussed at that meeting as it should have been. The presentation of the subject was hurriedly done. I think if Mr. Guldlin could have presented the thing as tersely at that meeting as now the subject would have been better understood at the meeting.

MR. DOTY—Mr. President, I would like to move that the Western Gas Association take official action upon the preparation and acceptance of an official classification covering the gas industry. The form presented by Mr. Guldlin covers his ripe experience and coincides largely with the experience of the jurors, and Mr. Guldlin's classification is a suggestion. It is not intended, of course, to be binding. Your judgment is the judgment which should prevail. If no better classification can be prepared, you can well afford to accept the classification which has been presented to you. In addition to my motion asking for the acceptance of this or better classification, I would like to add that the Western Gas Association request the adoption of a classification by our other associations engaged in the work of developing the gas industry. As Mr. Miller has said, the American Gas Light Association has gone upon record as approving a classification at that time. If the Western now approves, and the matter is approved by the other associations, we will have the unanimous support of the gas men, and carrying with it naturally the support of the men in the gas industry. The motion was seconded by Mr. Persons.

THE PRESIDENT—Do I understand, Mr. Doty, that you intend that the Association shall indorse this classification, or prepare a classification of its own?

MR. DOTY—If there is no better suggestion that can be made, we will endorse this one.

THE PRESIDENT—Gentlemen, you have heard the motion. Are there any suggestions? (The motion was adopted.) Mr. Baehr, have you anything to say on this subject?

MR. BAEHR—I don't believe that I can say anything about Mr. Guldlin's paper. I don't want to give him away. He ran away with—

MR. GULDLIN—I don't have to answer.

THE PRESIDENT—Mr. Guldlin, do you wish to make any further remarks?

MR. GULDLIN—I can only say that I thank you for the endorsement you have given my paper, and the classification which was the result of the combined efforts down there. If ever there should be an exposition again, we would not meet the conditions that we had to encounter and overcome. I believe it can be taken up now, and it will then be a matter of history, so that when, as undoubtedly will be the case in 10 or 12 years, we have a new exposition, the associations will immediately learn of such movement, be prepared to step right immediately in and demand such classification, or, if we don't get it, we don't take part in the exposition. Those expositions are run for the purpose of getting exhibitors, and also to commemorate some special event. I believe it would be—although I think your motion does away with that—there is not any necessity for it. I thank you very much for the opportunity of presenting the matter to you.

MR. PERSONS—Mr. President, in relation to that classification, I had occasion to go to Chief Hulbert along the last and get for you, I think, the classification as it stood on the records of the Manufacturers' Building. Chief Hulbert told me at that time that all future exhibitions would ask for their classification, and that this classification as it practically stands here would go down to all future expositions as it stands on the record at the Manufacturers' Building. So probably that matter will be taken care of by itself.

MR. GULDLIN—Well, in reply to what Mr. Persons says, I

will admit that that statement was made, but there were a good many other statements also made at the World's Fair, and we got to the point where we did not take anything for granted till we knew it. There was one way of getting the classification on the record, and that was to get the award. It had to get on the record then. On the 31st of December I was personally assured that the awards made by group 49, practically covering this classification, had been sustained by special resolution and spread on the minutes of the superior jury. I can assure you that, with the exception of one of the awards, which still is in dispute, the classification has been sustained by the awards being made. That I know.

THE PRESIDENT—With your permission, I think it would be well to instruct the Secretary to send a communication to the Portland, Ore., Exposition, informing them that the Western Gas Association has adopted this classification for use in exposition matters. If there are no objections the Secretary is so instructed.

MR. MILLER—I move that a vote of thanks be extended to Mr. Guldlin for having presented this matter in such a terse manner. (The motion was seconded by Mr. Persons and adopted.)

THE PRESIDENT—Mr. Guldlin is thanked. Is the Committee on Final Resolutions ready to report?

MR. MITCHELL—Mr. President and Gentlemen, I move that the thanks of this Association be extended to the Committee of Arrangements for their kind and courteous attention to the ladies of our party, and for the splendid dinner and entertainment given to the members of this Association last evening, and in the anticipated pleasure of a trip through the Chicago subway this afternoon; that this meeting will always be remembered as one of the many happy gatherings we have had in the city of Chicago. I move the adoption of this resolution. (The motion was seconded.)

THE PRESIDENT—Gentlemen, you have heard the motion. I put it with great pleasure. (The motion was adopted.) I wish personally to thank you all, gentlemen, for your hearty co-operation and assistance in making this meeting the success it has been.

MR. PERSONS—Gentlemen, I wish to move a vote of thanks to the officers of the Association for the efficient manner in which

they have brought off the meeting. (The motion was seconded. Mr. Persons put it to the meeting and it was adopted by rising vote.) Unanimous. Well, there is one man didn't get up.

THE PRESIDENT—Gentlemen, a motion to adjourn is in order.

THE SECRETARY—Mr. President, I move we adjourn. The motion was seconded and adopted, and the twenty-eighth annual meeting of the Western Gas Association adjourned *sine die*.

APPENDIX.

OFFICERS

OF THE

WESTERN GAS ASSOCIATION

1905-1906

President.

PAUL DOTY.....St. Paul, Minn.

First Vice President.

K. M. MITCHELL.....St. Joseph, Mo.

Second Vice President.

WM. ALFRED BAEHR.....St. Louis, Mo.

Secretary-Treasurer.

JAMES W. DUNBAR.....New Albany, Ind.

Editor Wrinkle Department.

BRYCE MCADAM.....Milwaukee, Wis.

DIRECTORS.

O. O. THWING	Cincinnati, O.	*Ex-Officio.*	
WALTON CLARK	Philadelphia, Pa.	Term Expires	1906
DANIEL R. WARMINGTON	Cleveland, O.	" "	1906
EDWIN E. WITHERBY	New York	" "	1906
WM. E. STEINWEDELL	Cleveland, O.	" "	1906
J. H. EUSTACE	Chicago, Ill.	" "	1907
C. H. DICKEY	Baltimore, Md.	" "	1907
F. B. WHEELER	Syracuse, N. Y.	" "	1907
GEORGE S. CLARK	Kansas City, Mo.	" "	1907

PAST PRESIDENTS.

*J. O. KING	1878–1879–1880
*THOMAS BUTTERWORTH	1881–1882
J. B. HOWARD	1883–1884
T. G. LANSDEN	1885
*JAMES SOMERVILLE	1886
*JOHN FULLAGAR	1887
EMERSON MCMILLIN	1888
GEORGE G. RAMSDELL	1889
*E. G. KING	Elected for 1890
CHARLES R. FABEN, JR	1890
FREDERICK EGNER	1891
E. G. COWDERY	1892
B. E. CHOLLAR	1893
*E. H. JENKINS	1894
ISAAC C. BAXTER	1895
A. W. LITTLETON	1896
W. H. ODIORNE	1897
JAMES T. LYNN	1898
*GEORGE TREADWAY THOMPSON	1899
WILLIAM MCDONALD	1900
I. C. COPLEY	1901
THOMAS D. MILLER	1902
A. H. BARRET	1903
F. H. SHELTON	1904
O. O. THWING	1905

PAST SECRETARIES.

LEE A. HALL	1878–1882
A. W. LITTLETON	1882–1894

*Deceased.

LIST OF MEMBERS

HONORARY MEMBERS

John P. Harbison ..... May, 1886
Hartford, Conn.

Austin C. Wood ..... May, 1889
216 North West street, Syracuse, N. Y.

C J. R. Humphreys ..... May, 1887
31 Nassau street, New York City.

Prof. T. C. Mendenhall ..... May, 1888
Hotel de la Paix, Florence, Italy.

F. E. Barker ..... May, 1891
Chairman Massachusetts Board of Gas and Electric Light Commissioners, 145 State House, Boston, Mass.

J. B. Howard ..... May, 1879
President The Gas Light Co. of Galena, Galena, Ill.

C. H. Nettleton ..... May, 1898
President Derby Gas Co. and New Haven Gas Light Co., Derby, Conn. Drawer L.

Thomas J. Cunningham ..... May, 1903
Editor *American Gas Light Journal*, 42 Pine street, New York, N. Y.

ACTIVE MEMBERS

Abell, W. A ..... May, 1905
Solicitor and Collector Gas and Electric Co , Taylorsville, Ill.

Adams, Henry E ..... June, 1904
Manager Stockton Gas and Electric Co., Stockton, Cal.

Addicks, W. R ..... May, 1895
Consulting Engineer Consolidated Gas Co., 4 Irving Place, New York City.

Aldrich, William A ..... June, 1904
C. H. Geist Co., Philadelphia, Pa.

Allen, William H ..... May, 1905
Commercial Agent, Public Service Corporation, 763 Broad street, Newark, N. J.

Ames, Knowlton L ..... June, 1904
President Benton Harbor and St. Joseph Gas Co., Benton Harbor, Mich. Residence 1306 Oak avenue, Evanston, Ill.

Andres, J. Frank ..... May, 1899
Suite 208 Houser Building, St. Louis, Mo.

Andrews, C. W ..... May, 1897
Manager Gas Department Zenith Furnace Co., office 411 Board of Trade, Duluth, Minn.

Andrews, J. Chas ..... June, 1904
Advertising Department and Secretary to Henry L. Doherty, 60 Wall street, New York City.

Atkinson, G. G ..... May, 1900
Superintendent Goshen Gas Co., Goshen, Ind.

Atwater, Christopher G ..... May, 1905
Mechanical Engineer United Coke and Gas Co., 17 Battery Place, New York City.

Averill, A. T ..... May, 1905
President Cedar Rapids Gas Light Co., Cedar Rapids, Ia.

Averill, Glenn M ..... May, 1893
Secretary Cedar Rapids Gas Light Co., Cedar Rapids, Ia.

Baehr, William Alfred ..... May, 1898
Engineer Laclede Gas Light Co., 716 Locust street, St. Louis, Mo.

Baer, Herbert S ..... May, 1905
General Manager Portage Lake Gas and Coke Co., Hancock, Mich.

Baker, James T ..... May, 1900
Manager River Shore Gas Co., Riverton, N. J.

Barret, A. H ..... May, 1879
Engineer Louisville Gas Co., Louisville, Ky.

Barthold, W. H ..... May, 1898
Engineer City Gas Co., Saginaw, Mich.

Battin, William I ..... May, 1900
Gas Engineer, 635 West 62nd Place, Chicago, Ill.

Baxter, Isaac C ..... May, 1885
Gas Engineer, Wayne Co. Bank Building. Detroit, Mich.

Beach, E. C ..... May, 1905
Manager Chicago Heights Gas Co., Chicago Heights, Ill.

Beal, William R ..... May, 1892
President Light, Heat and Power Co., Newburgh, N. Y.

Beardslee, Charles S ..... May, 1898
Superintendent Cleveland Gas Light and Coke Co., Front street, Cleveland, Ohio.

Bedard, Frank W ..... May, 1900
Manager Citizens Lighting Co., 601 First street, LaSalle, Ill.

Bell, Ernest Wm ..... May, 1900
245 East 61st street, Chicago, Ill.

Berger, E. T ..... May, 1905
Secretary Portage Lake Gas and Coke Co., Detroit, Mich.

Berkley, Joseph M ..... May, 1902
Chief Operator Gas Department Edison Electric Co., Los Angeles, Cal.

Berry, F. K ..... May, 1905
Sales Manager St. Paul Gas Co., and of the American Stove Co., St. Paul, Minn.

Bixby, Howard ..... June, 1904
Superintendent Gas Department Quincy Gas and Electric Co., Quincy, Ill.

Bixby, W. A ..... May, 1900
General Manager Gas and Electric Co., Quincy, Ill.

Blauvelt, Warren S ..... May, 1903
Superintendent Coke Oven Department Detroit Works of The Solvay Process Co., care of The Solvay Process Co., Detroit, Mich.

Blinks, Walter M ..... May, 1895
General Manager Gas Light Co., Kalamazoo, Mich.

Blowers, Frank W ..... May, 1900
Secretary and General Manager Kalamazoo Gas Company, Kalamazoo, Mich.

Boardman, A. E ..... May, 1887
Civil Engineer, Brevard, N. C.

Bowen, F. W ..... May, 1899
Secretary and Treasurer Montgomery Light and Water Power Co., Montgomery, Ala.

Bowers, W. L ..... May, 1900
Superintendent Davenport Gas and Electric Co., Davenport, Ia.

Bradley, Charles W ..... May, 1900
Superintendent Division St. Station Peoples Gas Light and Coke Co., Division street and Elston avenue, Chicago, Ill.

Bredel, Fred ..... May, 1889
(C. E.) Gas Engineer, 405 Keene street, Milwaukee, Wis.

Britsch, Mathias ..... June, 1904
Superintendent Peoples Gas Light and Coke Co., 24th Place and South Canal street, Chicago, Ill.

Britton, John A ..... May, 1900
General Manager California Gas and Electric Corporation, Rialto Building, San Francisco, Cal.

Brown, E. C ..... May, 1887
Publisher *Progressive Age*, 280 Broadway, New York.

Brown, J. S ..... May, 1896
Superintendent Clinton Gas Co., 174 Union street, Clinton, Mass.

Brown, R. B ..... May, 1901
Engineer Mlwaukee Gas Light Co., 182 Wisconsin street, Milwaukee, Wis.

Brundrett, E. L ..... May, 1900
General Auditor The United States Gas Improvement Co., 100 N. Broad street, Philadelphia, Pa.

Buck, Earl H ..... May, 1891
Plumbing and Heating Co., 114 Main street, Vincennes, Ind.

Burgess, C. F ..... May, 1905
Professor of Applied Electro Chemistry, University of Wisconsin, Madison, Wis.

Busch, John L ..... June, 1904
Superintendent Gas Department Decatur Railway and Light Co., 124 South Water street, Decatur, Ill.

Butterworth, Irvin ..... May, 1890
President and General Manager The Grand Rapids Gas Light Co., Grand Rapids, Mich.

Byers, C. A ..... May, 1895
Consulting Engineer, Toledo, Ohio.

Byron, Timothy ..... May, 1890
Superintendent Gas Co., Birmingham, Ala.

Calkins, W. B ..... June, 1904
Fairmont Coal Co., Fairmont, W. Va.

Callender, E. P ..... May, 1894
Editor *American Gas Light Journal*, 42 Pine street, New York City.

Cardell, J. H ..... May, 1894
Superintendent Gas Co., Huntsville, Ala.

Carson, George S ..... May, 1903
Vice-President Gas Co., Iowa City, Ia.

Cashions, Edward M.....May, 1900
Superintendent Glens Falls Gas and Electric Light Co., 11 Jay street, Glens Falls, N. Y.

Cathels, E.....May, 1890
Engineer Gas Co., Providence, R. I.

Caughlin, T. M.....May, 1902
Superintendent Gas Co., Vicksburg, Miss.

Chamberlain, Glenn R.....May, 1905
Secretary Grand Rapids Gas Light Co., Grand Rapids, Mich.

Chichester, Alfred A.....May, 1905
Peoples Gas Light and Coke Co., 485 East Forty-second street, Chicago, Ill.

Chollar, Byron E.....May, 1884
2840 Troost avenue, Kansas City, Mo.

Christie, W. H.....May, 1892
Superintendent Corning Gas and Electric Co., Corning, N. Y.

Chubb, Chester N.....June, 1904
Acting Superintendent Sioux Falls Gas Light Co., Sioux Falls, S. D.

Chubbuck, H. E.....June, 1899
Manager Citizens Lighting Co., LaSalle, Ill.

Clabaugh, G. W.....June, 1904
Vice-President and Secretary Omaha Gas Co.,Omaha, Neb.

Clarke, George S.....May, 1902
Engineer Kansas City Gas Co., 3rd and Gillis streets, Kansas City, Mo.

Clark, John C. D.....June, 1904
Superintendent Commercial Department, The Laclede Gas Light Co., 716 Locust street, St. Louis, Mo.

Clark, Walton.....May, 1885
Third Vice-President The United Gas Improvement Co., Broad and Arch streets, Philadelphia, Pa.

Clapp, G. N.....May, 1901
Secretary, Treasurer and General Manager The Middletown Gas and Electric Light Co., Middletown, Ohio.

Clary, E. D.....May, 1890
Secretary and Superintendent Gas Light Co., 215 Jefferson street, Burlington, Ia.

Cobb, Bernard C.....May, 1900
Secretary and General Manager Saginaw City Gas Co., Saginaw, Mich.

Cobb, S. P.....June, 1904
Assistant Engineer Laclede Gas Co., St. Louis, Mo.

Cole, William W.....May, 1900
General Manager Elmira Water, Light and Railroad Co., Realty Building, Elmira, N. Y.

Collins, Carroll ..... May, 1883
Gas Engineer, 314 Marion street, Elkhart, Ind.

Collins, Henry P ..... May, 1905
Superintendent Herkimer County Light and Power Co., Little Falls, N. Y.

Colvin, J. E ..... June, 1904
Superintendent of the Muncie Gas Light and Fuel Co., 301 East Main street, Muncie, Ind.

Connors, Mathias ..... May, 1905
Superintendent Universal Gas Co., 6802 Emerald avenue, Chicago, Ill.

Cooke, A. S ..... May 1899
Auditor United Gas and Electric Co., 40 Wall street, New York.

Copley, Ira Clifton ..... May, 1892
President Western United Gas and Electric Co., Aurora, Ill.

Cornish, R. C ..... May, 1900
Assistant Engineer Milwaukee Gas Light Co., Milwaukee, Wis.

Corscot, John ..... May, 1892
General Manager Madison Gas and Electric Co., Madison, Wis.

Cowdery, Edward G ..... May, 1885
Vice-President and General Manager The Laclede Gas Light Co , 716 Locust street, St. Louis Mo.

Cowdery, R. E ..... May, 1893
Superintendent Excelsior Gas Co., Topeka, Kas.

Crawford, Elmer ..... May, 1900
Superintendent Gas Co., Sterling, Ill.

Crawford, H. T ..... May, 1905
Cashier Gas Co., Waukegan, Ill.

Cressler, A. D ..... May, 1880
President Kerr-Murray Manufacturing Co., Ft. Wayne, Ind.

Crighton, D. K ..... May, 1905
Superintendent Cicero Station, Northwestern Gas Light and Coke Co , Oak Park, Ill.

Cronin, Ernest A ..... May, 1905
Assistant to Secretary, Missouri Gas Co., Kansas City, Mo.

Cross, Philip ..... May, 1898
Manager New Business Department, The Denver Gas and Electric Co., Denver, Col.

Crowell, F. B ..... May, 1905
Superintendent Gas Light Co., Atlanta, Ga.

Crowley, J. P ..... May, 1903
Secretary and Treasurer St. Paul Gas Light Co., St. Paul, Minn.

Cullinane, J. R ..... May, 1891
Manager West St. Louis Water and Light Co., St. Louis, Mo.

Cutcheon, Max. H.....June, 1904
Superintendent Gas Department, Wisconsin Traction, Light, Heat and Power Co., 780 College avenue, Appleton, Wis.

Danforth, G. C.....May, 1899
President Independence Gas and Coke Co., Independence, Mo.

Davis, David.....May, 1905
Secretary Litchfield Gas and Electric Co., Litchfield, Ill.

Davis, S. S.....May, 1890
Secretary Peoples Power Co., Address 3052 Tenth avenue, Rock Island, Ill.

Dawes, Rufus C.....May, 1900
620 New York Life Building, Chicago, Ill.

Dawson, George H.....May, 1905
Superintendent Station C, Western United Gas and Electric Co., LaGrange, Ill.

Day, C. L.....May, 1901
General Superintendent Street Department Peoples Gas Light and Coke Co., Chicago, Ill.

Deane, Edward M.....June, 1904
President Vincennes Light and Power Co., Vincennes, Ind. Residence Grand Rapids, Mich.

Dell, John.....Sept., 1878
President and General Manager Missouri Fire-Brick Co., 411 Olive street, St. Louis, Mo.

Diall, M. N.....May, 1900
General Manager Citizens Gas and Fuel Co., 636 Wabash avenue, Terre Haute, Ind.

Diall, Oliver M.....May, 1899
Superintendent Gas Co., Lockport, N. Y.

Dibbens, W. J.....May, 1905
Treasurer Guthrie Gas Co., 1123 Chamber of Commerce Building, Chicago, Ill.

Dickey, Charles H.....May, 1883
President Maryland Meter Co., North and Saratoga streets, Baltimore, Md. P. O. Box 773.

Dixon, J. Alfred.....May, 1893
General Superintendent Pintsch Compressing Co., 150 Broadway, New York.

Doan, J. P.....May, 1890
General Superintendent Jacksonville Gas Light and Coke Co., 224 South Main street, Jacksonville, Ill.

Doherty, Henry L.....May, 1898
General Manager and Chief Engineer American Light and Traction Co. Address 60 Wall street, New York City.

Donahue, E J.....May, 1902
Engineer Hudson County Division Gas Department Public Service Corporation of New Jersey, Sixth and Provost streets, Jersey City, N. J.

Doty, Paul ..... May, 1898
Vice-President and General Manager St. Paul Gas Light Co., St. Paul, Minn.

Dougherty, Ben. R ..... May, 1905
Richmond Water and Light Co., Richmond, Ky.

Dougherty, D. J. ..... May, 1903
Superintendent Gas Co., Jacksonville, Fla.

Douglas, H. W ..... May, 1889
Manager Gas Co., Ann Arbor, Mich.

Douthirt, W. F. ..... May, 1898
Secretary United Gas Improvement Co., Broad and Arch streets, Philadelphia, Pa.

Duffield, James C. ..... May, 1898
General Manager City Gas Co., London, Ontario, Canada.

Dunbar, C. H. ..... May, 1893
Secretary and Manager Houston Gas Co., Houston, Texas.

Dunbar, George L. ..... June, 1904
District Foreman Laclede Gas Co., St. Louis, Mo.

Dunbar, James W. ..... May, 1883
Superintendent United Gas and Electric Co., New Albany, Ind.

Duncan, F. C. ..... May, 1905
Assistant Secretary and Treasurer Gas Co., Galesburg, Ill.

Dunham, J. C. ..... May, 1899
Superintendent Pensacola Electric Terminal Railway Co., Pensacola, Fla.

Dunlap, H. ..... May, 1887
Treasurer Gas and Electric Co., Emporia, Kas.

Durrett, W. T. ..... May, 1901
Engineer Kentucky Heating Co., Louisville, Ky.

Earnshaw, Edward H ..... May, 1905
General Manager Gas Department Cincinnati Gas and Electric Co., Cincinnati, Ohio.

Eaton, W. M. ..... May, 1888
General Manager Railway and Light Co., Rochester, N. Y.

Egner, Frederic ..... May, 1884
Consulting Gas Engineer, Norfolk, Va. Box 902.

Elbert, V. L. ..... May, 1884
Engineer and Superintendent St. Paul Gas Light Co., St. Paul, Minn.

Elles, Edward J. ..... May, 1898
Secretary New Charlotte Gas Co., Charlotte, Mich.

Ellison, B. F. ..... May, 1897
General Manager Superior Water, Light and Power Co , Superior, Wis.

Elston, I. C., Jr. ..... May, 1901
President and Manager East St. Louis Gas Co., East St. Louis, Ill.

English, A. L. ..... June, 1904
Manager Citizens Gas and Electric Co., Council Bluffs, Ia.

Enright, J. H. ..... May, 1900
Superintendent and Purchasing Agent Carthage Light Co., Carthage, Mo.

Eustace, E. W. ..... May, 1901
Superintendent Gas Co., 125-127 N. Jefferson street, Peoria, Ill.

Eustace, J. H. ..... May, 1899
Engineer The Peoples Gas Light and Coke Co., 157 Michigan avenue, Chicago, Ill.

Evans, Charles H. ..... May, 1889
C. E. M. E., 924 Postal Telegraph Building, Chicago, Ill.

Evans, George B. ..... June, 1904
Superintendent Station "A" Laclede Gas Light Co., 148 Rutger street, St. Louis, Mo.

Eyman, L. E. ..... May, 1900
President and Treasurer The Pueblo Gas and Fuel Co., Pueblo, Col.

Eysenbach, Ernest E. ..... May, 1898
Manager Binghampton Gas Co., Binghampton, N. Y.

Faben, C. R., Jr. ..... May, 1885
General Manager Toledo Gas Light and Coke Co., 327 South Erie street, Toledo, Ohio.

Farr, Albert L. ..... May, 1905
Peoples Gas Light and Coke Co., Engineering Department, 157 Michigan avenue, Chicago, Ill.

Ferrier, James ..... May, 1889
President and Manager Rome Municipal Gas Co., Rome, Ga.

Ferris, W. J. ..... May, 1905
Secretary Monmouth Gas and Electric Co , Monmouth, Ill.

Feurtado, Russell Saville ..... May, 1905
General Superintendent Western Gas and Investment Co , Chicago, Ill.

Finnegan, Arthur ..... May, 1893
Superintendent Gas Light and Fuel Co., Granite City, Ill. Residence 927 Rutger street, St. Louis, Mo.

Fisher, D. G. ..... June, 1904
Superintendent Station B, Laclede Gas Light Co., St. Louis, Mo.

Fisher, John D. ..... May 1902
Owner Gas Plant, Baton Rouge, La.

Fitch, Henry D. ..... May, 1894
General Manager Gas Co., Bowling Green, Ky.

Fitz, Robert F. ..... May, 1890
Elgin, Ill. Box 101.

Fitzgerald, John H. ..... May, 1900
Houston, Texas. P. O. Box 293.

Fitzgerald, Leonard. ..... May, 1903
Superintendent North Shore Gas Co., Waukegan, Ill.

Fogg, Oscar H. ..... May, 1905
Engineer Consolidated Gas Co. of New York City, Flushing, L. I., N. Y.

Forbes, Charles. ..... May, 1903
Superintendent City Gas Co., London, Ont., Canada.

Forbes, James. ..... May, 1891
Superintendent Gas Co., 619 Cherry street, Chattanooga, Tenn.

Forstall, A. E. ..... May, 1888
Consulting Gas Engineer and Secretary Trustees Gas Educational Fund, room 22; 58 William street, New York City.

Fowles, Byron C. ..... June, 1904
Manager Pine Bluff Light and Water Co., Pine Bluff, Ark.

Frazer, David Henning ..... May, 1899
Treasurer and General Manager Battle Creek Gas Light Co., 26 East Main street, Battle Creek, Mich.

Freese, F. W. ..... May, 1888
Gas Plant Contractor, Fort Wayne, Ind. P. O. Box 13.

Freese, S. C. ..... May, 1897
Bloomington, Ind.

Frost, W. H. ..... May, 1893
General Manager Detroit Gas Light and Coke Co., 1998 River street, Delray, Mich.

Frueauff, Frank W. ..... May, 1900
Vice President and General Manager Denver Gas and Electric Co., 405 Seventeenth street, Denver, Col.

Fulkerson, S. O. ..... June, 1904
Superintendent St. Charles Light and Fuel Co., St. Charles, Mo.

Fullerton, George, Jr. ..... May, 1894
Superintendent Mohawk Gas Co., 6 Chestnut street, Schenectady, N. Y.

Gardner, W. H. ..... May, 1902
Treasurer and Manager Valparaiso Light and Fuel Co., 55 North Washington street, Valparaiso, Ind.

Geist, C. H. ..... May, 1903
President South Shore Gas and Electric Co., Chicago Beach Hotel, Chicago, Ill.

Gerould, Charles L. ..... May, 1899
American Water Works and Guarantee Co., Pittsburg, Pa.

Gibbons, James, Jr. ..... May, 1900
295 Fall street, Seneca Falls, N. Y.

Gille, Henry J. ..... May, 1905
General Superintendent St. Paul Gas Light Co., St. Paul, Minn.

Gillett, Mellville M. ..... May, 1899
Director Gas Light and Coke Co., Newark, Ohio.

Gimper, E H. ..... May, 1903
Spokane Falls, Wash.

Gimper, John. ..... May, 1879
Engineer and Superintendent Gas Co., Galveston, Texas.

Glasgow, A. G. ..... May, 1889
Of Humphreys & Glasgow, 38 Victoria street, S. W., London, Eng.

Glass, Shelton J. ..... May, 1896
Secretary American Light and Traction Co., 40 Wall street, New York City.

Goodnow, George F. ..... May, 1898
General Manager North Shore Gas Co., Waukegan, Ill.

Graf, Carl H. ..... May, 1905
General Manager Indianapolis Gas Co., Indianapolis, Ind.

Green, James ..... Sept. 1878
President Sedalia Gas and Fuel Co., and Moberly Gas and Electric Co. Address, Manchester and Sulphur avenues, St. Louis, Mo.

Greenough, M. S. ..... May, 1893
President and General Manager Cleveland Gas Light Co., Cleveland, Ohio.

Greim, O. F. ..... May, 1905
Superintendent Semet-Solway Company, Milwaukee, Wis.

Gribbel, John ..... May, 1890
Care John J. Griffin & Co., 1513 Race street, Philadelphia, Pa.

Griffin, T. M. ..... May, 1903
General Manager The Muncie Gas Light and Fuel Co., Muncie, Ind.

Griffith, J. L. ..... June, 1904
Superintendent Gas Co., Sedalia, Mo.

Gross, Alfred H. ..... May, 1905
President Sterling Gas Co., Sterling, Ill.

Gutsche, Edward J. ..... May, 1905
Chemist St. Paul Gas Co., St. Paul, Minn.

Haase, Ewald ..... May, 1902
Secretary and Treasurer Milwaukee Gas Light Co., 182 Wisconsin street, Milwaukee, Wis.

Haines, Jansen ..... May, 1903
Manager Capital City Gas Light Co., Des Moines, Ia.

Hammon, W. H. ..... May, 1903
Assistant General Manager Union Natural Gas Corporation, 1003 Farmers Bank Building, Pittsburg, Pa.

Harper, George H. ..... May, 1890
Manager Gas Co., Altoona, Pa.

Harrington, A. S. ..... May, 1905
Assistant Superintendent South Station, Peoples Gas Light and Coke Co., Chicago, Ill.

Hartman, William E. ..... May, 1903
Superintendent Joliet Works, Western United Gas and Electric Co., Joliet, Ill.

Hessenbach, George S. ..... June, 1904
Chief Draughtsman Laclede Gas Light Co., 716 Locust street, St. Louis, Mo.

Higgins, Henry C. ..... May, 1905
Vice President and Manager Lee County Lighting Co., Dixon, Ill.

Highlands, E. M. ..... May, 1899
With Consolidated Gas Co., Berwick, Pa.

Highlands, S. M. ..... May, 1892
President and General Manager Clinton Gas Light and Coke Co., Clinton, Ia.

Holman, C. L. ..... June, 1904
Secretary Laclede Gas Light Co., St. Louis, Mo.

Hood, John E. ..... June, 1904
Secretary and Treasurer The Knoxville Gas Co., Knoxville, Tenn.

Horton, Thomas O. ..... May, 1902
Secretary and Manager New York and Richmond Gas Co., 264 Bay street, Stapleton, N. Y.

Howard, Charles A. ..... May, 1901
President Aberdeen Gas Co., Aberdeen, S. D. P. O. Box 867.

Huber, Frank ..... May, 1901
Assistant Engineer Louisville Gas Co., Jackson and Washington streets, Louisville, Ky.

Humphrey, H. H. ..... May, 1905
President Gas Co., Jefferson City, Mo.

Humphreys, Alex. C. ..... May, 1892
Of the firm of Humphreys & Glasgow, and President Buffalo Gas Co., and President Stephens Institute Technology, 31 Nassau street, New York City.

Hutchinson, W. E. ..... May, 1905
Manager Gas Co., Hutchinson, Kas.

Hyde, Gustavus A. ..... May, 1890
Engineer Cleveland Gas Light and Coke Co., 356 Superior street, Cleveland, Ohio.

Hyde, Henry H. ..... May, 1900
Secretary and Manager Racine Gas Light Co., 305 Sixth street, Racine, Wis.

James, F. M. ..... May, 1905
Accountant Western United Gas and Electric Co., Aurora, Ill.

Jelliffe, Clifton N. ..... May, 1905
Auditor American Light and Traction Co., 40 Wall street, New York City.

Jenks, Ransaeller J. ..... May, 1905
Superintendent Evanston Division Northwestern Gas Light and Coke Co., Evanston, Ill.

Johnson, H. B. ..... May, 1905
Superintendent Gas Co , New Decatur, Ala.

Johnson, John O. ..... May, 1899
President The Columbus Gas Light and Heating Co., 39 North Front street, Columbus, Ohio.

Johnston, John P. ..... May, 1905
Manager Consumers Gas Co., Princeton, Ind.

Jones, C. D. ..... May, 1888
President Gas Co., Independence, Ia.

Jones, E. C. ..... May, 1891
Engineer Gas Department, California Gas and Electric Corporation, 630 Rialto Building, San Francisco, Cal.

Jones, J. Oswell ..... June, 1904
Superintendent Meter Repair Department, Laclede Gas Light Co., 2655 Adams street, St. Louis, Mo.

Jones, T. C. ..... May, 1895
President Delaware Gas Co., 6 West Winter street, Delaware, Ohio.

Keller, C. M ..... May, 1881
Secretary, Superintendent and General Manager Columbus Gas Light and Coke Co., 312 Washington street, Columbus, Ind.

Kelly, Fred. W ..... May, 1901
Secretary and Manager Peoples Light Co., Davenport, Ia.

Kellogg, L. L ..... May, 1899
Vice-President and Manager Sioux City Gas and Electric Co., 528 Fifth street, Sioux City, Ia.

Kenan, Norman G ..... May, 1889
President The Cincinnati Gas and Electric Co., corner Fourth and Plum streets, Cincinnati, Ohio.

Kennedy, John M ..... May, 1881
Steam, Gas and Hot Water Fittings, 118 North Main street, Rockford, Ill.

Kersting, Albert F ..... May, 1902
Foreman Distribution Department South Shore Gas and Electric Co., Hammond, Ind.

Kincaid, H. E ..... May, 1899
Superintendent and Secretary The Citizens Gas Light Co., Jackson, Tenn.

King, Joseph H ..... June, 1904
Superintendent Calumet Division, South Chicago, Ill., Peoples Gas Light Co., 3607 Ellis avenue, Chicago, Ill.

Knapp, Isaac N ..... May, 1900
Gas Engineer, Ardmore, Pa., P. O. Box 496.

Knight, Charles S ..... May, 1884
Fort Wayne, Ind.

Knight, J. J ..... May, 1894
Vice-President Kalamazoo Gas Co., 123 South West street, Kalamazoo, Mich.

Kraft, R. P ..... June, 1904
Superintendent West Side Works Milwaukee Gas Light Co., Milwaukee, Wis.

Landon, Hugh McK ..... May, 1898
Secretary and Treasurer Manufacturers Natural Gas Co., 113 Monument Place, Indianapolis, Ind.

Lane, Frank K ..... May, 1895
Superintendent Gas Co., Fishkill Landing, N. Y.

Lane, Frederick K ..... May, 1905
Treasurer and Manager Seattle Lighting Co., Seattle, Wash.

Lane, Robert M ..... May, 1905
Peoples Gas Light and Coke Co., 157 Michigan avenue, Chicago, Ill.

Lathrop, A. P ..... May, 1897
Vice-President and General Manager Detroit City Gas Co., 230 Woodward avenue, Detroit, Mich.

Law, A. R ..... June, 1904
1401 American Security Building, New York City.

Levings, W. H ..... May, 1905
Secretary Gas Light Co., Minneapolis, Minn.

Light, George ..... May, 1888
Assistant Superintendent Gas Co., Dayton, Ohio.

Light, Joseph ..... May, 1883
Engineer and Superintendent Dayton Gas Light and Coke Co., 203 East Fifth street, Dayton, Ohio.

Little, F. W ..... May, 1897
Vice-President Peoria Gas and Electric Co., 125 North Jefferson avenue, Peoria, Ill.

Littleton, A. W ..... Sept., 1878
Care London City and Midland Bank, London, E. C., England.

Lloyd, Ernest F ..... May, 1898
President Adrian (Mich.) Gas Co., and Vice-President Lloyd Construction Co., 860 Greenwood avenue, Detroit, Mich.

Lorenz, John ..... May, 1901
General Manager Gas and Electric Co., Jackson, Miss.

Logan, John D ..... May, 1894
Vice-President Newton Gas Co., Newton, N. J. Address Box 6, Station G, Brooklyn, N. Y.

Luther, F. E ..... May, 1902
Superintendent Ogden Gas Co., Hawthorne avenue and Wilton street, Chicago, Ill.

Lynn, J. T ..... May, 1889
402 Union Trust Company Building, Detroit, Mich.

Lynn, John R ..... May, 1894
619 Market street, Portsmouth, Ohio.

Lyons, B. F ..... June, 1904
Assistant Engineer Laclede Gas Light Co., 716 Locust street, St. Louis, Mo.

Macbeth, A. B ..... May, 1901
Assistant Engineer Kansas City Gas Co., Third and Gillis streets, Kansas City, Mo.

MacKay, Charles ..... May, 1888
Superintendent Gas Co., Watertown, Wis.

MacMillan, George ..... May, 1885
President, Treasurer and General Manager LaCrosse Gas and Electric Co., 222 Main street, LaCrosse, Wis.

Mainland, Sinclair ..... May, 1905
Treasurer Green Bay Light and Power Co., Green Bay, Wis.

Mainland, William M ..... May, 1899
Oshkosh, Wis.

Malone, M. E ..... May, 1899
Superintendent Gas Department, Denver Gas and Electric Co., Denver, Col.

Mansur, John H ..... May, 1895
President Keystone Meter Co., Royersford, Pa. Also President Consolidated Schuylkill Gas Co., Phoenixville, Pa. Address 436 Walnut street, Royersford, Pa.

Marcott, Henry R ..... May, 1901
Address unknown.

Markhus, O. G. F ..... June, 1904
General Manager Union Light, Heat and Power Co., Fargo, N. D.

Markley, Joseph C ..... May, 1905
Engineer South Shore Gas and Electric Co., 621 New York Life Building, Chicago, Ill.

Marshall, F. L ..... June, 1904
Superintendent Gas and Electric Co., Enid, Okla. Territory.

Marshall, William D ..... May, 1903
General Superintendent New Orleans Lighting Co., 1643 Perdido street, New Orleans, La.

Maxon, J. H ..... May, 1900
Secretary and Manager Gas Light Co., Columbus, S. C.

Mayers, J. Alexander ..... May, 1899
Gas Engineer Contractor, 56 Pine street, New York City.

Maynard, H. B ..... May, 1900
Manager Gas Co., Elkhart, Ind.

McAdam, Bryce ..... May, 1895
Superintendent of Distribution Milwaukee Gas Light Co., 406 Bradford street, Milwaukee, Wis.

McClary, Nelson A ..... May, 1885
President Northwestern Gas Light and Coke Co., 184 LaSalle street, Chicago, Ill.

McCorkindale, William J ..... June, 1904
General Manager The Sherman Gas Light and Fuel Co., Sherman, Texas.

McDonald, Donald ..... May, 1897
President Kentucky Heating Co., Louisville, Ky.

McDonald, W. B ..... May, 1905
Manager Evansville Gas and Electric Co., Evansville, Ind.

McDonald, William ..... May, 1883
Gas Meter Manufacturer, (D. McDonald & Co.) 51 Lancaster street, Albany, N. Y.

McIlhenny, John D ..... May, 1895
President Gas Co. of Montgomery County, Norristown, Pa. Address 1339 Cherry street, Philadelphia, Pa.

McKay, William E ..... May, 1892
Engineer in charge Boston Consolidated Gas Co., Dudley Road, Milton, Mass.

McKee, J. M ..... May, 1902
Superintendent Gas Co., Meridian, Miss. P. O. Box 285.

McLaughlin, R. A ..... May, 1905
General Superintendent Galesburg Gas and Electric Co., Galesburg, Ill.

McLean, George ..... May, 1898
President The Key City Gas Co., 669 Main street, Dubuque, Ia. P. O. Drawer 438.

McMillin, Emerson ..... May, 1885
President The American Light and Traction Co., office 40 Wall street, New York City.

Meagher, John B ..... May, 1898
301 East Main street, St. Paul, Minn.

Meeker, Charles A ..... May, 1903
President Gas Co., Muncie, Ind.

Miller, Alten S ..... May, 1890
Manager Consolidated Gas Co., Lexington and Liberty streets, Baltimore, Md.

Miller, Carroll ..... May, 1903
Consulting Engineer, 155 Michigan avenue, Chicago, Ill.

Miller, Ira A ..... May, 1900
Assistant Secretary and Superintendent Colorado Springs Light and Power Co., 111 East Kiowa street, Colorado Springs, Col.

Miller, Robert S ..... May, 1905
Engineer Muncie Gas Light and Fuel Co., Muncie, Ind.

Miller, Thomas D ..... May, 1893
Manager New Orleans Lighting Co., 201 Baronne street, New Orleans, La.

Miller, William A ..... May, 1896
Care Stacey Manufacturing Co, 2847 Eastern avenue, Cincinnati, Ohio.

Miller, W. B ..... June, 1904
Treasurer Birmingham Railway, Light and Power Co., 2104 First avenue, Birmingham, Ala.

Milligan, A. L ..... May, 1905
Department Solvay Process Co., South Chicago, Ill.

Mitchell, Kerr M ..... May, 1889
General Manager St. Joseph Gas Co., St. Joseph, Mo.

Mockett, W. E ..... May, 1903
General Manager and Engineer The Dallas Gas and Fuel Co., Dallas, Texas.

Moore, H. M ..... May, 1905
Superintendent Gas Co., Austin, Texas.

Moore, Northrop ..... May, 1901
Assistant Secretary Wyandotte Gas Co., Kansas City, Kas.

Moran, G. M ..... June, 1904
Superintendent Sedalia Gas and Fuel Co., 119 East 2nd street, Sedalia, Mo.

Morehead, John M ..... May, 1905
Chemist Peoples Gas Light and Coke Co., 157 Michigan avenue, Chicago, Ill.

Morgans, William H ..... May, 1884
Secretary and Superintendent Gas Co., Pontiac, Mich.

Morrell, Edward E ..... May, 1890
Vice-President and Engineer DeKalb County Gas Co., DeKalb, Ill.; Sterling Gas and Electric Light Co., Sterling, Ill. Address 221 Wesley avenue, Oak Park, Ill.

Morton, Harry E.....May, 1903
Manager Boone Gas Co., Boone, Ia.

Moses, Frank D.....May, 1891
Constructing Engineer and Contractor, 7 North Stockton street, Trenton, N. J.

Murdock, George T.....May, 1884
Treasurer and Manager Elkhart Gas Light and Coke Co., Elkhart, Ind.

Murdock, James W.....May, 1886
District Manager Gas Co., Joliet, Ill.

Murdock, S. T.....May, 1898
Secretary and General Manager Lafayette Gas Co., Lafayette, Ind.

Murphy, Charles A.....May, 1903
Manager Ottawa Gas Light and Coke Co., Ottawa, Ill.

Neely, J. D. S.....May, 1896
General Superintendent Lima Gas Light Co., 612 West Market street, Lima, Ohio.

Newberry, F. E.....May, 1905
Manager Citizens Gas Co., Kankakee, Ill.

Norland, Manning A.....May, 1903
Assistant Engineer Peoples Gas Light and Coke Co., 157 Michigan avenue, Chicago, Ill.

Norris, Rollin.....May, 1900
Superintendent of Works, The United Gas and Improvement Co., Broad and Arch streets, Philadelphia, Pa.

Nutting, C. H.....May, 1899
Superintendent Chicopee Gas Light Co., 37 Gaylor street, Chicopee, Mass.

Odiorne, William H.....May, 1884
Vice-President Clinton Gas Co., Clinton, Ill. Residence 1010 South Second street, Springfield, Ill.

Old, George.....May, 1901
Superintendent Gas and Electric Light Co., 210 St. George street, St. Augustine, Fla. P. O. Box 747.

Olds, Howard L.....May, 1899
General Manager and Superintendent City of Lincoln Gas Co., Lincoln, Ill.

O'Malley, P.....May, 1896
Engineer Aurora and Joliet Gas Companies. Residence, Aurora, Ill.

Osborn, M. C.....May, 1905
Manager Commercial Department Butte Electric Light, Gas and Power Co., Butte, Montana.

Page, Carter H., Jr.....May, 1894
Commercial Agent The U. G. I. Co., Broad and Arch streets, Philadelphia, Pa. P. O Box 1564.

Parker, Joseph R. ..... May, 1905
Engineer Gas Co., Hancock, Mich.

Patten, J. A ..... May, 1905
Superintendent Manitowoc Gas Light Co., Manitowoc, Wis.

Paulins, W. C ..... June, 1899
Superintendent Pueblo Gas and Fuel Co., 1221 West Twelfth street, Pueblo, Col.

Pearson, John R ..... May, 1903
General Manager and Assistant to President Indianapolis Gas Co., Indianapolis, Ind.

Pease, A. C ..... May, 1905
Superintendent Gas Co., Lowell, Mass.

Pelton, F. K ..... May, 1900
Secretary Natural Gas, Electric Light and Power Co., 402 Union Trust Building, Detroit, Mich.

Perkins, B. W ..... May, 1880
Superintendent South Bend Fuel and Gas Co., 301 East Jefferson street, South Bend, Ind.

Petley, Benjamin H ..... May, 1901
Manager Seattle Electric Co., 1419 Thirty-seventh avenue, Seattle, Wash.

Planck, J. W ..... May, 1900
Superintendent Choctaw Gas Light, Heat and Power Co., South McAlester, Indian Ter.

Plumb, F. W ..... June, 1904
Secretary The Gas Light Co. of Augusta, Ga., 809 Broad street, Augusta, Ga.

Pollitt, L. Irving ..... May, 1901
Manager Gas Plant, Pine Bluff, Ark.

Porter, Joseph F ..... May, 1902
President and Treasurer Alton Gas and Electric Co., 205 Market street, Alton, Ill.

Powell, W. E ..... May, 1894
Manager Gas Co., Logansport, Ind.

Pratt, E. G ..... May, 1888
Vice-President and Manager Gas Light Co., 182 Wisconsin street, Milwaukee, Wis.

Price, F. L ..... May, 1905
Superintendent Highland Bank, North Shore Gas Co., Highland Park, Ill.

Printz, Eugene ..... May, 1883
Superintendent and Secretary Zanesville Gas and Coke Co., Zanesville, Ohio.

Pullen, James T ..... June, 1904
Superintendent Jackson Gas Light Co., Jackson, Miss.

Purcell, Theodore V. ..... May, 1903
General Manager Ogden Gas Co., 115 Dearborn street, Chicago, Ill.

Putnam, W. R. ..... May, 1900
Secretary and Manager Red Wing Gas and Electric Co., Red Wing, Minn.

Quinn, A. K. ..... May, 1898
Manager Gas Co., 181 Thomas street, Newport, R. I.

Ramsdell, George G. ..... May, 1879
Gas Engineer, 530 Broadway, New York City.

Rand, A. T. ..... May, 1905
President Minneapolis Gas Light Co., Minneapolis, Minn.

Rees, Richard ..... May, 1905
Secretary Memphis Gas and Electric Co., Memphis, Tenn.

Reger, W. S. ..... June, 1904
Superintendent Meter and Fitting Department Laclede Gas Co., 2655 Adams street, St. Louis, Mo.

Reitemeyer, A. F. ..... May, 1903
Superintendent, Secretary and Treasurer Perth Amboy Gas Light Co., Perth Amboy, N. J. (Address 1088 Elizabeth ave., Elizabeth, N. J.)

Rettew, G. H. ..... June, 1904
Superintendent Greenville Gas and Electric Light and Power Co., Greenville, S. C.

Rew, Irwin ..... May, 1900
Treasurer DeKalb County Gas Co., and Sterling Gas and Electric Light Co., 184 LaSalle street, Chicago, Ill.

Rice, H. L. ..... May, 1905
General Manager Western United Gas and Electric Co., Aurora, Ill.

Richards, Fred. M. ..... May, 1905
Superintendent of Manufacture Madison Gas and Electric Co., Madison, Wis.

Riselay, W. S. ..... May, 1899
Secretary and Treasurer Buffalo Gas Co., 188 Main street, Buffalo, N. Y.

Ritschy, Lewis J. ..... June, 1904
2631 Virginia avenue, St. Louis, Mo.

Rochat, Henry ..... May, 1902
Superintendent Indianapolis Gas Co., Indianapolis, Ind.

Roper, George D. ..... May, 1890
Vice President Boone Gas Co., Rockford, Ill.

Roney, J. W. ..... May, 1898
Secretary and Manager Richmond Light, Heat and Power Co., Richmond, Ind.

Ross, Alexander ..... May, 1890
President Boise Gas Light Co., Boise, Idaho.

Runner, R. K. ..... June, 1904
Manager DeKalb County Gas Co., 347 Main street, DeKalb, Ill.

Runner, Z. T. F. ..... May, 1882
Secretary and Manager Freeport Gas Light and Coke Co., 156 Stephenson street, Freeport, Ill.

Russell, John K. ..... May, 1901
Superintendent Gas Co., Sheboygan, Wis.

Salter, W. James. ..... May, 1894
Superintendent Gas Department Light and Railway Co., Meridian, Miss.

Searle, R. M. ..... May, 1899
Engineer Gas Department Westchester Lighting Co., First avenue and First street, Mt. Vernon, N. Y.

Schenck, Rudolph ..... June, 1904
Assistant Engineer Peoples Gas Light and Coke Co., 157 Michigan avenue, Chicago, Ill.

Schmidt, Emil G. ..... May, 1905
General Manager Springfield Gas Light Co., Springfield, Ill.

Schott, W. H. ..... June, 1904
Engineer and President Bloomington, Indiana, Gas Co., 1218-1222 Marquette Building, Chicago, Ill.

Schwarm, C. A. ..... May, 1905
General Superintendent and Manager Joplin Gas Co., Joplin, Mo.

Scott, Emmet ..... May, 1905
Treasurer Petoskey, Bay View Gas Co. Address LaPorte, Ind.

Scott, Henry C. ..... June, 1904
President Ft. Wayne (Texas), Light and Power Co.; President Wichita Gas and Electric Light Co.; President Waco (Texas), Gas Co. Address Bank Commerce Building, 420 Olive street, St. Louis, Mo.

Shattuck, A. F ..... May, 1905
Chief Chemist The Solvay Process Co., Detroit, Mich.

Shattuck, J. D ..... May, 1898
Manager Suburban Gas Co. of Philadelphia, 517 Market street, Chester, Pa.

Shearn, John ..... May, 1902
Brown Palace Hotel, Denver, Col.

Shelton, F. H ..... May, 1889
Gas Engineer and Secretary various Gas Companies, Fifteenth and Chestnut streets, 1004 Pennsylvania Building, Philadelphia, Pa.

Shepard, F. C ..... May, 1905
Superintendent Minneapolis Gas Co., Minneapolis, Minn.

Shockley, Ben. J. ..... May, 1905
Manager and Treasurer Albert Lea Light and Power Co., Albert Lea, Minn.

Shumway, J. N ..... May, 1905
Manager Gas and Electric Co., Taylorsville, Ill.

Sinsel, Otis A ..... May, 1905
Results Foreman Detroit Gas Co., Detroit, Mich.

Slade, Richard E ..... May, 1901
General Manager and Treasurer Gas Light Co., 700 Main street, Hartford, Conn.

Slater, A. B ..... May, 1894
558 Fifth avenue, New York City.

Sloan, J. C ..... May, 1900
Superintendent Gas Co., Port Huron, Mich.

Small, J. C ..... May, 1889
Secretary and Treasurer Gas Light, Coal and Coke Co., Aurora, Ind.

Soden, W. T ..... May, 1887
Director Electric Light and Gas Co., Emporia, Kas.

Sombart, W. E ..... May, 1899
Secretary and Treasurer Sombart Gas Co., Booneville, Mo.

Speer, R. I ..... May, 1902
Secretary and Manager Pulaski Gas Light Co., Little Rock, Ark.

Spencer, F. S ..... May, 1899
411 Manhattan avenue, New York City.

Spinning, W. V ..... May, 1903
Manager Peru American Gas Co., 17 West Third street, Peru, Ind.

Springer, E. S ..... May, 1903
Manager Leavenworth Light and Heating Co., Leavenworth, Kas.

Stacey, James E ..... May, 1894
President and General Manager Stacey Manufacturing Co., Elmwood Place, Ohio.

Stacey, J. Frank ..... May, 1896
Superintendent and General Manager Gas Co., Nashville, Tenn.

Stannard, Clare N ..... June, 1904
Contracting Agent Denver Gas and Electric Co., 415 Seventeenth street, Denver, Col.

Steinwedell, Carl S ..... May, 1905
Care Electric & Power Co., Butte, Montana.

Steinwedell, George ..... June, 1904
Statistician Denver Gas and Electric Co., Denver, Col.

Steinwedell, William ..... May, 1887
Quincy, Ill.

Steinwedell, W. E ..... May, 1899
Secretary The Gas Machinery Co., 719 Citizens Building, Cleveland, Ohio.

Stephens, A. K. ..... May, 1901
Superintendent Gas Light and Fuel Co., Nyack, N. Y.

Stephens, H. H. ..... May, 1899
Secretary and Manager Brookfield Gas, Electric and Heating Co., Brookfield, Mo.

Stiles, A. K. ..... May, 1892
President Streator Gas and Light Co., Streator, Ill.

Stiles, H. B. ..... May, 1905
Auditor St. Paul Gas Light Co., St. Paul Minn.

Strain, G. A ..... May, 1901
Superintendent New York and Queens Gas Co., Flushing, N. Y.

Stratton, C. J. ..... May, 1905
Salesman Peoples Gas Light and Coke Co., Chicago, Ill.

Strohn, Clarence B. ..... May, 1905
District Manager Western United Gas and Electric Co., Aurora, Ill.

Strohn, R. N ..... June, 1904
Treasurer Western United Gas and Electric Co., Aurora, Ill.

Sullivan, R. B ..... June, 1904
Secretary and Treasurer Denver Gas and Electric Co., Denver, Col.

Summers, George ..... May, 1900
Assistant Engineer with Peoples Gas Co., 1147 Lurt avenue, Rodger Park, Chicago, Ill.

Summers, Louis D. ..... May, 1901
Superintendent United Gas and Electric Co., 253 Spring street, Jeffersonville, Ind.

Swann, Harry R. ..... May, 1891
Chief Inspector Louisville Gas Co., 1022 Floyd street, Louisville, Ky.

Sweetman, M. M. ..... May, 1897
Superintendent Kansas Natural Gas Co., 1526 Wabash avenue, Kansas City, Mo.

Taylor, Bankson ..... May, 1898
London, England.

Taylor, George H. ..... May, 1883
Secretary, Treasurer and Superintendent Warren Gas Light Co., 209 Main street, Warren, Ohio.

Templeton, E. S. ..... May, 1899
Attorney at Law and President Greenville Gas Co., Greenville, Pa.

Thwing, O. O. ..... May, 1893
Superintendent West End Works, Cincinnati Gas and Electric Co., Cincinnati, Ohio.

Tippey, B. O. ..... May, 1899
Superintendent of Manufacture Detroit City Gas Co., Detroit, Mich.

Traver, A. F. ..... May, 1905
Superintendent Manufactures, Grand Rapids Gas Co., Grand Rapids, Mich.

Travis, F. M. ..... May, 1902
Treasurer Torrington Electric Co., 58 Church street, Torrington, Conn.

Tucker, C. A. ..... June, 1904
Assistant Secretary Rochester Railway and Light Co., Rochester, N.Y.

Turneaure, F. E. ..... May, 1905
Dean College of Engineers University of Wisconsin, Madison, Wis.

Turner, Thomas ..... May, 1891
President and General Manager City Railway, Gas and Electric Light Co., Charlestown, S. C.

Vance, S. M. ..... June, 1904
Superintendent Bristol Gas and Electric Co., 416 State street, Bristol, Tenn. Va.

Vollum, Wm. Hobson ..... May, 1903
General Superintendent Suburban Gas Co., Chester, Pa.

von Maur, J. D. ..... June, 1904
Superintendent Street Department Laclede Gas Co., 716 Locust street, St. Louis, Mo.

Wakeman, A. E. ..... June, 1904
Superintendent Glens Falls Gas and Electric Light Co., 32 Warren street, Glens Falls, N. Y.

Walbridge, H. D. ..... May, 1889
Banker, 7 Wall street, New York City.

Wallace, William ..... Sept. 1878
Superintendent Lafayette Gas Co., Lafayette, Ind.

Walker, Edwin M. ..... May, 1899
Manager Gas and Electric Co., 416 State street, Bristol, Tenn.

Walker, Sidney R. ..... May, 1901
Assistant Superintendent Station "A" Laclede Gas Light Co., 148 Rutger street, St. Louis, Mo.

Walsh, James T. ..... May, 1903
Gas Engineer Western Electric Co., 575 West Adams street, Chicago, Ill.

Walters, B. S. ..... May, 1902
C. H. Leist Co., Philadelphia, Pa.

Wainright, Arthur V. ..... May, 1901
Superintendent Norwalk District Conn. Railway and Lighting Co., South Norwalk, Conn. Box 365.

Waring, George H. ..... May, 1901
Superintendent Omaha Gas Co., Twentieth street and Lincoln avenue, Omaha, Neb.

Warmington, Daniel R ..... May, 1891
Vice President and General Manager The Peoples Gas Light Co., 410 Pearl street, Cleveland, Ohio.

Warmington, George H. ..... May, 1899
President The Peoples Gas Light Co., 410 Pearl street, Cleveland, Ohio.

Warnking, George ..... May, 1900
Secretary Gas Co., Berlin, Wis.

Watt, Robert ..... June, 1904
Address Unknown.

West, William D ..... May, 1901
445 Second avenue, Detroit, Mich.

Westcott, J. T ..... May, 1894
Manager Economical Gas Apparatus Construction Co., 19 Abingdon street, Westminster, S. W., London, England.

Wheeler, Fred. B ..... May, 1902
Gas Engineer Semet-Solvay Co., Syracuse, N. Y.

Whipple, Henry S ..... May, 1888
Manager Rockford Gas Light and Coke Co., 201 Mulberry street, Rockford, Ill.

White, W. F ..... June, 1904
Vice-President The North American Gas Co., 30 Broad street, New York.

Whitcomb, H. D. Jr ..... June, 1904
General Manager Gas Department Public Service Corporation of N. J., 575 Broad street, Newark, N. J.

Whitfield, Albert ..... June, 1904
Gas Light Contractor, 79 South Clark street, Chicago, Ill.

Whitted, Thomas B ..... June, 1904
Care Westinghouse Machine Co., 1225 Chemical Building, St. Louis, Mo.

Whitton, W. H ..... June, 1904
Purchasing Agent Laclede Gas Light Co., St. Louis, Mo.

Whysall, George ..... May, 1894
General Manager Columbus, Delaware and Marion Ry. Co., Columbus, Ohio.

Wilkinson, A. L ..... May, 1905
Secretary and Treasurer Goshen, Indiana, Gas Co. Address 402 Union Trust Building, Detroit, Mich.

Williams, L. S ..... May, 1901
Manager The W. G. I. Co., 27 North Third street, Harrisburg, Pa.

Williamson, John ..... May, 1891
Consulting Engineer Peoples Gas Light and Coke Co., 157 Michigan avenue, Chicago, Ill.

Witherby, Edwin E ..... May, 1898
General Manager United Gas and Electric Co., 40 Wall street, New York City.

Wolff, S. E ..... May, 1905
Manager Gas Co., Saginaw, Mich.

Woods, George E. ..... May, 1892
Engineer of Manufacture Consolidated Gas Co., 4 Irving Place, New York City.

Woodward, Ralph ..... May, 1893
General Manager Pittsfield Coal Gas Co., Pittsfield, Mass.

Wortendyke, I. F. ..... May, 1905
Superintendent New Gas Light Co., Janesville, Wis.

Wright, E. J. H ..... May, 1905
Secretary Northwestern Gas Light and Coke Co., Oak Park, Ill.

Young, James M. H ..... May, 1905
Superintendent Joplin Gas Co., Joplin, Mo.

Young, John ..... May, 1892
Consulting Superintendent Allegheny Heating Co., 603 West Diamond street, Allegheny, Pa.

Young, Peter ..... May, 1892
Secretary Conneaut (Ohio) Gas Light and Fuel Co., 202 Lewis Building, Pittsburg, Pa.

Young, P. S. ..... May, 1900
763 Broad street, Newark, N. J.

Young, Robert ..... May, 1892
Manager Gas Co., Cheboygan, Mich.

Zeek, C. F ..... May, 1901
Superintendent Pensacola Gas Co., 25 and 27 East Garden street, Pensacola, Fla.

ASSOCIATE MEMBERS.

Alcott, F. L.....May, 1900
Second Vice-President American Stove Co., care Standard Lighting Co., Cleveland, Ohio.

Ambler, Thomas M.....May, 1901
Manager St. Louis Department Welsbach Co., 1011 Olive street, St. Louis, Mo.

Asendorf, Carl.....May, 1905
Representative Maryland Meter Co., Chicago, Ill.

Barbour, George H.....June, 1904
Vice-President and General Manager The Michigan Stove Co., Detroit, Mich.

Barbour, W. T.....May, 1901
President Detroit Stove Works, Detroit, Mich.

Barnes, George W.....May, 1900
Salesman Equitable Meter Co., 434-444 First avenue, Pittsburg, Pa

Bartlett, F. V.....June, 1904
General Manager Ideal Manufacturing Co., Detroit, Mich.

Best, F. W.....May, 1901
Manufacturers Agent Gas and Electric Fixtures. Address No. 17, City National Bank Building, Utica, N. Y.

Black, Ben. Alten.....May, 1905
Advertiser, 111 World Building, New York City.

Bigelow, Lucius S.....June, 1904
President Light Publishing Co., 265 Broadway, New York City, N. Y.

Bingham, Robert W.....June, 1904
Traveling Representative for Welsbach Lighting Co., of America, 218 LaSalle street, Chicago, Ill.

Borst, Emil.....May, 1905
Representative Bartlett, Hayward Co., Baltimore, Md.

Brewer, Robert R.....June, 1904
President Brewer-Clark Co., 714 North Taylor street, St. Louis, Mo.

Brill, Alfred P.....June, 1904
Assistant to President, Rund Manufacturing Co., 340 Second avenue, Pittsburg, Pa.

Brown, C. H.....May, 1905
President Brown & Wortham Co., Des Moines, Ia.

Brownell, E. E.....May, 1905
B. E. E., Consulting Electrical Engineer, Dayton, Ohio. Business address, 157 Michigan avenue, Chicago, Ill.

Buckley, John C.....May, 1899
Traveling Salesman George M. Clark & Co., 72 East Lake street, Chicago, Ill.

Buel, Theodore D. ..... May, 19
President Detroit Meter Co., Detroit, Mich.

Callahan, A. F. ..... May, 19
President Outlook Envelope Co , 1355 Railway Exchange, Chicago, Il

Callenbach, Dr. J. Anton, Ph. D ..... May, 18
718 Niagara avenue, Sheboygan, Wis.

Carpenter, H. A ..... May, 18
Engineer Riter-Conley Manufacturing Co., Pittsburg, Pa.

Carney, M. J ..... May, 19
General Manager Acetylene Manufacturing Co., 157 Michigan avenue Chicago, Ill.

Carter, Thomas B ..... May, 19
Engineer City Lighting, 326 City Hall, St. Louis, Mo.

Clark, George M. ..... May, 189
Manufacturer of Gas Stoves, 72 Lake street, Chicago, Ill.

Claybourne, C. W. ..... May, 189
General Manager Claybourne Burner Co., Oil and Gas Saving Appli ances, 1770 Old Colony Building, Chicago, Ill.

Collins, David J ..... May, 189
Sales Agent The United Gas Improvement Co., 1403 Arch street Philadelphia, Pa.

Collins, Harry S ..... May, 19
Assistant General Manager Woodward & Tiernan Co , St. Louis, Mo

Collins, Warren ..... June, 19
Stamford Gas Stove Co., Stamford, Conn.

Corbus, F. G ..... May, 189
Manager Welsbach Co., Philadelphia, Pa.

Cressler, George H. ..... May, 19
Secretary Kerr, Murray Manufacturing Co., Fort Wayne, Ind.

Cruse, Arthur R ..... May, 19
President Cruse & Kemper Co., 1205 Girard Building, Philadelphia, Pa

Darling, William S ..... May, 19
Manager Practical Gas Construction Co., North Chicago, Ill.

Day, Ernest D ..... May, 19
Address unknown.

Dean, Mark ..... June, 19
116 Nassau street, New York. Box 913.

Dickel, W. L ..... May, 19
Young's Hotel, Boston, Mass.

Dickey, E. S ..... May, 19
Treasurer Maryland Meter Co., Baltimore, Md.

Dickey, P S.....May, 1889
Agent Maryland Meter and Manufacturing Co., Baltimore, Md.

Dods, John C.....May, 1900
Superintendent and Engineer Edgar Zinc Co., Cherryvale, Kas.

Douglas, R. C.....May, 1905
Gas Engineer, 804 Rector Building, Chicago, Ill.

Dresser, S. R.....May, 1903
Manufacturer of Couplings and Specialties for Gas and Water Lines, Bradford, Pa.

Dwyer, Francis T.....May, 1897
Vice-President and Secretary The Ideal Manufacturing Co., Detroit, Mich.

Eaton, Alfred B.....May, 1896
Western Sales Agent United Gas Improvement Co., 70 Wabash avenue, Chicago, Ill.

Eilbeck, A. B.....May, 1896
40 Wall street, New York City.

Eisner, Joseph M.....June, 1904
President The Instantaneous Water Heating Co., 153-159 South Jefferson street, Chicago, Ill.

Elliott, H. J.....May, 1900
Sale Agent Pittsburg Coal Co., 203 Railway Exchange Building, Chicago, Ill.

Flinn, Charles F.....May, 1905
Salesman Westinghouse Machine Co., 171 LaSalle street, Chicago, Ill.

Flower, Walter L.....May, 1905
Steam Specialties, 5111 Vernon avenue, St. Louis, Mo.

Fuertado, R. S.....May, 1905
General Superintendent Western Gas and Investment Co., Chicago, Ill.

Gassett, A. L.....May, 1894
Secretary of Economy Stove Co., Cleveland, Ohio.

Gilman, George P., Jr.....May, 1903
Vice-President Lindsay Light Co., 195-197 Michigan street, Chicago, Ill.

Green, J. L.....May, 1905
Vice-President Laclede Fire Brick Co., St. Louis, Mo.

Gregory, George H.....May, 1905
149 Church street, New York City.

Guldlin, O. N.....May, 1888
President The Western Gas Construction Co., 535 West Berry street, Ft. Wayne, Ind.

Harper, H. D.....May, 1886
Manager Chicago Branch, D. McDonald & Co., 99 South Jefferson street, Chicago, Ill.

Hayward, S. F. ..... May, 1891
Secretary and Treasurer Connelly Iron Sponge and Governor Co., 395 Broadway, New York.

Healan, R. H. ..... May, 1905
Acetylene Co., 157 Michigan avenue, Chicago, Ill.

Heffern, Charles S. ..... June, 1904
The Enos Co., 371 Fifth avenue, New York.

Helme, William E. ..... May, 1889
Of Helme & McIlhenny, 1339 Cherry street, Philadelphia, Pa.

Henderson, E. H. ..... May, 1895
Address unknown.

Henry, W. G. ..... May, 1899
Vice-President Detroit Stove Works, 2921 South LaSalle street, Chicago, Ill.

Hicks, George C., Jr. ..... June, 1904
Engineer P. H. & F. M. Roots Co., Connersville, Ind.

Higgins, C. M. ..... May, 1890
Standard Oil Co., 26 Broadway, New York City.

Hobdell, George, Jr. ..... May, 1905
Manager Phoenix Meter Co., 2834 Elsworth street, Philadelphia, Pa.

Hopton, L. R. (M. E.) ..... June, 1904
Superintendent The Enos Co., Makers of Lighting Fixtures, 371 Fifth avenue, New York City.

Horton, A. W ..... May, 1905
Western Sales Agent Pittsburg Coal Co., 203 Railway Exchange, Chicago, Ill.

Hulswit, Frank T. ..... May, 1905
Manager Child, Hulswit & Co., 411 Michigan Trust Building, Grand Rapids, Mich.

Isbell, Charles W. ..... May, 1894
President Isbell-Porter Co., 257 Broadway, New York.

Jacobs, Charles H. ..... May, 1896
Secretary, Treasurer and General Superintendent Detroit Meter Co., Detroit, Mich.

Jenks, L. B. ..... May, 1905
Sales Agent Youngstown Iron Sheet & Tube Co., 937 Marquette Building, Chicago, Ill.

Johnston, E. D. ..... May, 1899
President and General Manager P. H. & F. M. Roots Co., Connersville, Ind.

Johnston, F. G. ..... May, 1905
Superintendent Welsbach Co., 101 East Sixth street, St. Paul, Minn.

Kahn, Lazard ..... May, 1896
Stove Manufacturers F. and L. Kahn & Bros., Hamilton, Ohio.

Kellum, Benjamin J. ..... May, 1903
Western Manager Welsbach Co., 68-70 Wabash avenue, Chicago, Ill.

Keech, George C. ..... May, 1901
Secretary Empire Electric Supply Co., 334 Dearborn street, Chicago, Ill.

Lea, Henry I., ... May, 1903
Gas Engineer The Westinghouse Machine Co., East Pittsburg, Pa.

Leakey, N. G. ..... May, 1901
Assistant Secretary Michigan Ammonia Works, Detroit, Mich.

Leavenworth, Mark ..... June, 1904
Western Manager Rund Manufacturing Co., 307 Wood street, Pittsburg, Pa.

Leiter, Joseph ..... May, 1905
Coal Miner, 81 South Clark street, Chicago, Ill.

Leonard, W. H. ..... May, 1900
Department Manager Standard Oil Co., 5 Wabash avenue, Chicago, Ill.

Lindsay, Charles R. Jr., ... May, 1900
President Lindsay Light Co., 195-197 Michigan street, Chicago, Ill.

Lockwood, W. A. ..... May, 1905
Western Salesman Ringen Stove Co., St. Louis, Mo.

Logan, William J. ..... May, 1891
President Logan Iron Works, Commercial and Clay streets, Brooklyn, E. D., New York.

Lotz, Alfred ..... June, 1904
Mechanical Engineer with American Blower Co., 1550 Marquette Building, Chicago, Ill.

Lovett, Edward C. ..... May, 1905
Salesman William M. Crane Co., 100 Wisconsin avenue, Oak Park, Ill.

MacDonald, Albert ..... June, 1904
Superintendent Metric Metal Works, Erie, Pa.

Marquis, P. S. ..... May, 1890
Manager Barrett Manufacturing Co., 1100 Fullerton Building, St. Louis, Mo.

Martin, J. H. T. ..... May, 1902
President The J. H. T. Martin Co., 198 West Broadway, New York City.

Martin, W. W. ..... June, 1904
Lindsay Light Co., 1113 Pine street, St. Louis, Mo.

Mayer, Frederick J. ..... May, 1885
Mechanical Engineer Bartlett, Hayward & Co., Scott and McHenry streets, Baltimore, Md.

McDonald, Donald ..... May, 1899
Manager D. McDonald & Co., 51 Lancaster street, Albany, N. Y.

McIlhenny, John ..... May, 1884
Meter Manufacturer, 1339 Cherry street, Philadelphia, Pa.

Melcher, C. W..... May, 1
Western Manager Ingersoll, Sargeant Co., Chicago, Ill.

Merrifield, L. L..... May, 1
Gas Engineer, 157 Dowling avenue, Toronto, Canada.

Miller, Fred A..... June, 1
Manager S. R. Dresser's Coupling Business, 208 South aven
Bradford, Pa.

Milsted, William N..... May, 1
Eleventh avenue and Forty-seventh street, New York City.

Moon, O. P..... May, 1
Manager Standard Lighting Co., Cleveland, Ohio.

Morava, W..... May, 1
President Morava Construction Co., 1245 Marquette Building, Chica
Ill.

Mordue, Thomas N..... May, 1
Coal Merchant and Resident Manager for Castner, Curran a
Bullitt, Old Colony Building, Chicago, Ill.

Mueller, Henry..... May, 1
Vice-President H. Mueller Manufacturing Co., Decatur, Ill.

Olmsted, George G..... June, 19
With Farson, Leach & Co., Investment Securities, 140 Dearbo
street, Chicago, Ill.

Ordway, Lucius P..... May, 19
General Manager of Crane & Ordway, St. Paul, Minn.

Osborn, H. H..... June, 19
Salesman Michigan Stove Co., 36 Loomis street, Chicago, Ill.

Osius, George..... May, 18
Secretary and Treasurer Michigan Ammonia Works, Detroit, Mich.

Parker, G. W..... May, 19
Eastern Agent Parker-Russell Mining and Manufacturing Co ,
Broadway, New York City.

Pattan, W. H..... May, 19
Gas Engineer, 6109 Washington avenue, Chicago, Ill.

Payne, F. H..... May, 19
Manager Metric Metal Works, 143 East Sixth street, Erie, Pa. P. (
Box 472.

Persons, F. R..... May, 18
Representative Maryland Meter Co., 317 South St. Clair street, Toled
Ohio.

Plantinga, P..... May, 19
President The Gas Machinery Co., 719 Citizens Building, Clevelan
Ohio.

Platt, E. S..... May, 18
Address Unknown.

Peterson, Carl H ..... May, 1900
Assistant General Agent Safety Car Heating and Lighting Co., 1017 Monadnock Building, Chicago, Ill.

Polk, Roger W ..... May, 1905
Gas Engineer, Laclede Fire Brick Manufacturing Co., St. Louis, Mo.

Porter, R. G ..... May, 1905
Engineer, Riter, Conley Manufacturing Co., Pittsburg, Pa.

Pratt, Henry ..... May, 1905
Boiler & Machine Co., 875 South Halsted street, Chicago, Ill.

Prendergast, Daniel J ..... May, 1897
General Superintendent Welsbach Street Lighting Co., of America, 318 West 42nd street, New York City.

Printz, Charles H ..... May, 1905
Sales Agent Western Gas Construction Co., Fort Wayne, Ind.

Puffer, W. L ..... May, 1901
Care J. B. Frahui Co., Wholesale Coal, Davenport, Iowa.

Reilly, James A ..... May, 1901
Traveling Salesman The Queen City Coal Co., Fifth and Freeman avenue, Cincinnati, Ohio.

Reynolds, M. G ..... June, 1904
President and General Manager The Johnson-Reynolds Co., Anderson, Ind.

Russell, Daniel R ..... May, 1883
Vice-President Parker-Russell Mining and Manufacturing Co., 417 Pine street, St. Louis, Mo.

Schall, H. D ..... May, 1903
Salesman Detroit Stove Works, 2921 South LaSalle street, Chicago, Ill.

Scott, Thomas J ..... May, 1905
Iron & Coal, 1623 Locust street, St. Louis, Mo.

Seeger, Robert ..... May, 1905
District Manager Welsbach Street Lighting Co., of America, 712 Roe Building, St. Louis, Mo.

Sherburne, Joseph M ..... May, 1905
With Edward Miller & Co., 48 LaSalle street, Chicago, Ill.

Shirra, John C ..... May, 1903
Western Sales Agent The New Gas Progress Range Co., 457 Cass street, Milwaukee, Wis.

Stacey, A. J ..... May, 1900
Representative Stacey Manufacturing Co., 239 Mill street, Cincinnati, Ohio.

Stadelman, W. A ..... June, 1904
Manager Wellman-Seaver Morgan Co., 42 Broadway, New York.

Stephens, J. G ..... May, 1897
General Sales Agent, 306 Shetland avenue, Pittsburg, Pa.

Steward, Robert Bruce ..... May, 1900
Vice-President The D. M. Steward Manufacturing Co., Chattanooga, Tenn.

Strain, J. R ..... May, 1905
Salesman Rathbone, Lard & Co., Chicago, Ill.

Stratton, S. S ..... May, 1887
Agent Maryland Meter Co., 88-92 West Jackson Boulevard, Chicago, Ill.

Tracy, Joseph F ..... May, 1905
Representative Meyer Supply Co., 22 South street, St. Louis, Mo.

Tarvin, R. J ..... May, 1885
Secretary and Treasurer The Stacey Manufacturing Co., Elmwood Place, Ohio.

Terhune, Charles F ..... May, 1900
Vice-President William M. Crane Co., 1133 Broadway, New York.

Ummach, Charles E ..... May, 1905
Secretary and Treasurer R. Williamson & Co., 88-92 West Washington street, Chicago, Ill.

Van Wie, Edwin G ..... May, 1893
Manager Department of Gas Appliances, Detroit Stove Works, 1320 Jefferson avenue, Detroit, Mich.

Whirl, J. J ..... May, 1895
Ideal Manufacturing Co., 73 Brainard street, Detroit, Mich.

Whitaker, M. C ..... May, 1905
General Superintendent Welsbach Co., Gloucester, New Jersey.

Whittenmore, Clinton L ..... June, 1904
Manager Western Branch Monarch Water Heater Co., 1232 Olive street, St. Louis, Mo,

Wickham, E. F ..... June, 1904
Ziegler Coal, 724 Commercial Building, St. Louis, Mo.

Wickham, Leigh ..... May, 1892
Agent Parker-Russell Mining and Manufacturing Co., 417 Pine street, St. Louis, Mo.

Wilkins, John T ..... June, 1904
Mechanical Engineer of The Connersville Blower, Co., Connersville, Ind.

Witherden, G. M ..... May, 1892
Representative John J. Griffin & Co., 1513 Race street, Philadelphia, Pa.

Woodward, Walter B ..... May, 1905
Vice-President Woodward & Tiernan Ptg. Co., 5108 Raymond avenue, St. Louis, Mo.

Wortham, F. L ..... May, 1905
Secretary and Treasurer Brown & Wortham Co., Contractors of Gas Plants, Des Moines, Iowa.

Zitzewitz, Herman ..... May, 1905
President National Machine Works, Sheffield and North avenue, Chicago, Ill.

Honorary Members	8
Active Members	437
Associate Members	145
Total	590

MEMBERS DECEASED.

Kerr Murray	Fort Wayne, Ind	May	6, 1880
*Thos. Butterworth	Rockford, Ill	April	5, 1885
Geo. E. Downing	New York City		1885
†Alfred Odiorne	No date of death or city.		
†T. E. Scobeg	No date of death or city.		
†Jos. M. McLean	No date of death or city.		
*J. O. King	Jacksonville, Ill	April	16, 1887
N. W. Jones			1887
J. M. Murphy	Baltimore, Md	Aug.	25, 1888
J. G. Miller	Green Bay, Wis	Mar.	2, 1889
Thos. Smith	Grand Rapids, Mich.	Mar.	5, 1889
F. M. Roots	Connersville, Ind	Oct.	25, 1889
*E. J. King	Jacksonville, Ill	Oct.	28, 1889
*John Fullagar	San Jose, Cal	April	29, 1890
Theobald Forstall	Chicago, Ill	Jan.	19, 1890
S. H. Douglas	Ann Arbor, Mich	Aug.	26, 1890
Frank Beck	Galveston, Tex	Sept.	14, 1890
Enoch Veal	Boonville, Mo	Nov.	10, 1890
R. Woodmansee	Davenport, Iowa	Dec.	5, 1890
W. H. Down	New York City	Feb.	15, 1891
E. M. Starr	Richmond, Ind	April	28, 1891
E. M. Russell	St. Louis, Mo	May	28, 1891
G. A. Hyde, Jr	Cleveland, O	June	11, 1891
Edwin Lee Brown	Chicago, Ill	July	21, 1891
Samuel Pritchett	Nashville, Tenn	Sept.	21, 1891
Geo. Shepard Page	New York City	Mar.	26, 1892
G. A. McIlhenny	Washington, D. C.	Oct.	16, 1892
J. J. Griffin	Philadelphia, Pa	Oct.	22, 1892
Geo. W. Ewing	East St. Louis, Ill	Dec.	18, 1892
J. F. Rodgers	New Decatur, Ala	Dec.	31, 1892
H. S. Walbridge	Toledo, O	Jan.	1, 1893
Peter E. DeMill, Jr	Detroit, Mich	June	27, 1893
Henry C. Felt	Cincinnati, O	Jan.	10, 1895
Geo. H. Wells	Nashville, Tenn	Jan.	26, 1895
Hon. Jos. Russell Thomas	New York City	Nov.	28, 1896
Richard Spencer	Burlington, Iowa	Oct.	16, 1896
Geo. S. Harris	Mansfield, O	June	14, 1897
A. E. Smythe	Chicago, Ill	July	9, 1897

* Past Presidents.
† Reported at 1886 Meeting.

J. D. Thompson	St. Louis, Mo	Feb.	15, 1898
H. C. Balcom	Winona, Minn	Feb.	11, 1899
B. P. Holmes	Youngstown, O	Feb.	13, 1899
Jerome Croul	Detroit, Mich	Sept.	26, 1899
James Gardner, Jr	Pittsburgh, Pa	Jan.	16, 1900
James M. Starr	Richmond, Ind	June	9, 1900
Henry Renshaw	Cincinnati, O	June	30, 1900
M. J. Payne	Kansas City, Kan	July	17, 1900
*Geo. Treadway Thompson	Denver, Colo	Oct.	1, 1900
H. Wilkiemeyers	Evansville, Ind	Nov.	20, 1900
D. L. Cathels	Louisville, Ky	Nov.	21, 1900
F. O. Ellsworth	Chicago, Ill	Jan.	9, 1901
Trumbull Russell	St. Louis, Mo	May	26, 1901
Wm. E. Barrows	Philadelphia, Pa	July	30, 1901
Wm. Wallace Goodwin	Bordentown	Oct.	6, 1901
*E. H. Jenkins	San Antonio, Tex	June	25, 1902
Julius Buss	Milwaukee, Wis	Nov.	23, 1902
H. B. Leach	Taunton, Mass	July	25, 1903
A. S. Bushnell	Springfield, O	June	15, 1904
Thomas Littlehales	Syracuse, N. Y	April	10, 1904
C. W. Blodget	New York City	Aug.	25, 1904
A. Hickenlooper	Cincinnati, O	May	12, 1904
A. B. Slater	Providence, R. I	June	26, 1904
Wm. Henry White	New York City	July	3, 1904
Oscar B. Webber	New York City	Sept.	16, 1904
Charles E. Hess	Jefferson City, Mo	Dec.	22, 1904
F. E. Gallagher	Shrevesport, La	Aug.	16, 1904
*James Somerville	Indianapolis, Ind	Feb.	13, 1905
A. H. Branch	Oklahoma City		

* Past Presidents.

CONSTITUTION AND BY-LAWS

OF THE

WESTERN GAS ASSOCIATION

PREAMBLE.

Whereas. It is necessary that those to whom is intrusted the manufacture and sale of gas for illuminating and other purposes, should endeavor by every means within their power, to improve its quality to the highest and reduce its cost to the lowest practical limit, thereby meeting the just expectation of both producer and consumer; and, believing that by united action only, can results so desirable be accomplished, we do hereby ordain and establish this constitution for the Western Gas Association.

CONSTITUTION.

ARTICLE I.

SECTION 1. Only officers and regular employes of gas companies shall be eligible for election to active membership.

SEC. 2. Any person who may be directly or indirectly connected with the gas industry, or who may be skilled therein, shall be eligible as an associate member. Such members shall be proposed, balloted for and received in the same manner and be subjected to the same fees and dues as active members, and shall be entitled to all the privileges and courtesies of the Association, except the right to hold office; but associate members may be transferred to active membership by vote of the Association, upon the recommendation of the Board of Directors.

SEC. 3. Election to membership shall be by ballot, and a three-fourths vote shall be necessary to elect.

ARTICLE II.

SECTION 1. The officers of the Association shall consist of a President, two Vice-Presidents and a Secretary-Treasurer, who shall be elected for one year.

SEC. 2. There shall also be eight Directors, four of whom shall be elected at each annual meeting, and whose term of office shall be for two years; providing, that upon the adoption of this Constitution and By-Laws, the first Board elected thereunder shall be composed of eight members, four of whom shall be elected for one year, and four of whom shall be elected for two years.

SEC. 3. The Past Presidents of the Association shall be ex-officio. Members of the Board of Directors and all other officers shall be elected by ballot.

SEC. 4. All officers shall retain their positions until their successors have qualified.

ARTICLE III.

SECTION 1. The management of the affairs of the Association shall be intrusted to the officers as a Board of Directors, under the general direction of the members in convention.

SEC. 2. A majority of the Board shall constitute a quorum, and the Board shall have power to fill any vacancies that may exist therein.

ARTICLE IV.

SECTION 1. Only active members shall hold office, but no voting by proxy shall be allowed.

ARTICLE V.

SECTION 1. This Association shall have the power to enact, amend and enforce all necessary by-laws and rules; to provide penalties for their violations; to assess and collect fees and dues for membership; and provide a benefit fund for the relief of members and their families.

ARTICLE VI.

SECTION 1. Any proposition to amend this Constitution shall be submitted at a regular meeting, and seconded by a majority of all the members present; the proposition shall not be acted upon until the next regular meeting, when if approved by two-thirds of all the members who may be present at said meeting, it shall become a part of the Constitution.

BY-LAWS.

ARTICLE I.

ANNUAL MEETINGS.

The annual meeting of the Association shall be held on the third Wednesday in May of each year, and at such place as shall be determined upon at the preceding annual meeting, at which time the election of officers shall take place and annual reports and settlements be made. At each annual meeting the President shall present an address, setting forth his official acts and such general items and recommendations as he may deem of advantage to the Association. All general business of the Association shall be transacted at these annual meetings, and the following shall be the order of business.

Calling the roll and reading of minutes.

President's address.

Presenting application for membership and balloting.

Introduction of new members.

Reports of standing committees.

Reports of special committees.

Miscellaneous business, which may be laid aside informally and taken up at any time.

Special order for the presentation of papers, drawings or models, or other matters of interest to the Association entitled to consideration under its rules, in the discussion of which all the members shall be entitled to participate, and such special order may be considered at any time by vote of the Association.

ARTICLE II.

APPLICATION FOR MEMBERSHIP.

Any person desiring to become a member of the Association shall make his application in writing, giving name, residence and occupation, with proper references, and signed by two members of the Association; but no such application shall be acted upon until the fee for membership is paid.

ARTICLE III.

FEES AND DUES.

SECTION 1. The fees for membership shall be ten dollars, which shall include dues for the first year, and the yearly dues shall be five dollars, payable annually in advance thereafter.

SEC. 2 The secretary shall drop from the roll the name of any member who shall be in arrears for two years' dues after giving thirty days notice.

SEC. 3. The Board of Directors shall have power to reinstate a member, who, for non-payment of dues, has been suspended or dropped from the roll, when such member shall have paid the full amount due at the time his membership ceased.

ARTICLE IV.

DUTIES OF OFFICERS.

SECTION 1. The President, or in the event of his absence, the Vice-Presidents, in their order, shall preside over the meetings of of the Association or of the Board of Directors. He shall enforce all laws and rules of the Association, and shall appoint all committees not otherwise provided for. He shall decide all questions of order, subject only to an appeal, but in all cases it shall require at least a majority of the members present to overrule his decision. He shall sign the records and have general supervision of the affairs of the Association. He shall also choose subjects and select authors for the papers which shall be presented for the consideration of the Association at its next annual meeting.

SEC. 2. The Secretary-Treasurer shall attend all meetings of the Association and of the Board of Directors; shall have charge of the books, papers and other property of the Association, and perform such other duties as may properly belong to his office.

ARTICLE V.

QUORUM.

A quorum for the transaction of business shall consist of not less than fifteen members, but a smaller number may adjourn from day to day for not more than three days; and in case of the absence of the President or other proper officers, they may select a chairman to preside over the meeting.

ARTICLE VI.

BOARD OF DIRECTORS.

SECTION 1. The Board of Directors shall meet at least once in each year, on the day preceding the annual meeting of the Association, at which time they shall determine in regard to the propriety of the various papers, drawings, models, or other matters constituting the special order, being laid before the Association.

SEC. 2. When, in the judgment of a majority of the Board of Directors, it shall be deemed advisable to change the place or date of the meeting, or both, as designated by the Association at the last annual meeting, the Board shall have power to make such change or changes.

SEC. 3. Said Board shall annually, immediately after its own organization, elect a finance committee of three, from its own number, who shall have power to examine at any time, the books and accounts of the Secretary-Treasurer; said committee shall also, on the morning of the first day of the annual meeting, examine the report of the Secretary-Treasurer, audit his accounts and report thereon to the Association, provided that no officer whose accounts may be subject to examination, shall under any circumstances, be a member of such examining committee. The Board of Directors, at the same meeting, shall also appoint a committee of three, from their own number, whose duty it shall be to examine and report on applications for membership.

SEC. 4. The Board of Directors shall also cause a record of its proceedings to be kept, which shall be submitted to the Association during the first day of the annual meeting.

ARTICLE VII.

A person whose service in the gas profession has been meritorious may be elected to honorary membership whose name has first been submitted to the Board of Directors, and recommended by them to the Association.

ARTICLE VIII.

PAPERS, DRAWING, ETC.

All papers, drawings, models, etc., submitted to the Association

at its annual meetings shall remain the property of those presenting the same.

ARTICLE IX.

REJECTED APPLICATIONS.

If any person proposed for membership shall, upon being balloted for, be rejected, no notice of such proposal shall be incorporated in the minutes.

ARTICLE X.

TRIALS AND PUNISHMENTS.

Any person may upon conviction of violating any of the laws or rules of the Association, or of conduct unbecoming a gentleman, be suspended for a definite time, or expelled from the Association, by a vote of at least three-fourths of all the members present, provided, that any such accused member shall be furnished with a copy of the charges against him at least ten days before his trial, and be allowed an opportunity to appear either in person or by counsel, for his defense.

ARTICLE XI.

RULES.

The business sessions of the Association shall be conducted in accordance with the requirements of Robert's Rules of Order.

ARTICLE XII.

SPECIAL MEETINGS.

Special meetings of this Association may be called by the President, by and with the written consent of a majority of the Board of Directors. He shall cause notices to be issued to all the members of the Association at least thirty days prior to such meeting; said notice to state the business for which such meeting has been called, and no other business than that mentioned in such notice shall be considered.

ARTICLE XIII.

AMENDMENTS.

These By-laws may be altered or amended only in the following manner:

SECTION 1. Any proposition to alter or repeal an existing By-law, shall be presented in writing during an annual meeting, at any time before its adjournment, seconded by not less than three members, shall be read twice, and if approved by two-thirds of all the members present, shall become a part of these By-laws; but no such alteration or amendment shall affect any question pending at the time of its adoption.

SEC. 2. Any additional section to these By-laws, not in conflict with any existing By-laws, may be adopted at any annual meeting upon being presented in writing, duly seconded, read twice, and approved by at least two-thirds of all the members present.

THE "THOMPSON LIBRARY."

Gift of Mr. Geo. Treadway Thompson.

The following rules were adopted by the Association at Annual Meeting, May 15th, 1901.

1. The library shall be known as "The Thompson Memo Library" of the Western Gas Association.

2. A standing library committee of five shall be appoint composed of the President and Secretary of the Association a three other members.

3. The Secretary of the Association shall be custodian of t library.

4. The committee shall have power to make rules for t proper conduct of the library, and to expend such sums may be necessary to carry out these rules.

5. That only members of the Western Gas Association good standing shall be eligible as borrowers.

6. That a deposit shall be required from borrowers of at le the catalogue value of the book.

7. The members borrowing books shall pay expense transportation.

8. That books shall not be loaned for a period of more th 15 days, with the privilege of 15 days renewal, upon applicati to the Secretary.

9. That renewals only be granted when no other applicati for the same book is on file

10. That a fine of at least one per cent. of catalogue value l imposed for each day a book is retained beyond the allowed tim

11. That the Secretary shall not have power to remit fines.

THE THOMPSON LIBRARY.

ASSOCIATION PROCEEDINGS.

	No. Vols.
American Gas Light Association, 1875-1905	21
American Society of Mechanical Engineers, 1895-97	2
Incorporated Gas Institute Transactions, 1896	1
Pacific Coast Gas Association, 1893-1902	4
Society of Gas Lighting, 1885-1891	3
Souvenir History A. G. L. A.	1
Western Gas Association, 1887-1892-1892-1896-98-99	4
American Gas Light Journal, 3 Vol. donated by J. B. Howard, Galena, Ill., 1, 2 and 3	3
Proceedings New England Association Gas Engineers, 1900-01	1
Proceedings Ohio Electric Light Association, 1903	1
Proceedings Ohio Gas Light Association, 1901-2-3-4	2
Question Box Ohio Gas Light Association, 1904	1
All American Gas Wrinkles, 1891-1900, published by Western Gas Association	1
Proceedings of Gas Congress, 1904	1

CHEMISTRY.

Bayles' Chemist's Pocket Book	1
Beebe's Laboratory Manual	1
Beilstein's Chemical Analysis, Tr. C. O. Curtman, 5th Ed., 1883	1
Chemistry for Beginners, Edward Hart, 3rd Ed., 1896	1
Chemistry of Illuminating Gas, N. H. Humphrey, 1891	1
Elements of Chemistry, James Shepard, 1885	1
Gas Engineers' Laboratory Hand Book, Hornby, 1894	1
Notes on Qualitative Analysis, Mason, 1896	1
Organic Chemistry for the Laboratory, Noyes	1
Organic Chemistry, Ira Ramsen	1
Volumetric Analysis, Sutton, 5th Ed.	1
Ammonia and Ammonia Compound, Arnold, Tr. Colman, 2nd Ed., 1890	1

COAL GAS.

Bibliography of Coal Gas, W. R. Chester, 1892	1

COAL TAR.

Distillation of Coal Tar, Lunge	1

ENGINEER'S TEXT BOOKS.

No.

Book of Standard National Tube Works, 1891 .....
Carnegie-Phipps & Co's. Pocket Companion, 1892 .....
Engineer's Surveying Instrument, Baker .....
Engineer's Sketch Book, Thomas Barber, 2nd Ed., 1890 ....
Engineer's Contract and Specifications, Johnson, 1st Ed., 189:
Mechanics' and Engineer's Pocket Book, Haswell 55th Ed..
Principles of Graphic Statics, Clark, 2nd Ed., 1888 .....
Theory and Practice Modern Framed Structures, Johnson, 3rd Ed., 1894 .....
Proceedings Brooklyn Engineers' Club, 1899-1903 .....

FUELS.

Calorific Power of Fuels, Poole, 1st Ed .....
Liquid Fuels, Hodgetts .....
Combustion of Coal, Barr, donated by J. B. Howard, Galena, Ill.

GAS MANUFACTURE.

Manufacturers of Gas, William Burns, 1887 .....
Gas Manufacture and Assay of By-Products, Butterfield ....

GAS TEXT BOOKS.

American Gas Engineer and Superintendent's Hand Book, William Mooney, 1888 .....
Construction and Workings of Regenerator Furnaces, Graham, 1894 .....
Gas and Oil Engines, G. Richmond .....
Gas Lighting and Gas Fitting, Gerhard .....
Incandescent Gas Lighting, Wm. Gentsch .....
Modern Street Lighting, Wm. Sugg, 2nd Ed., 1897 .....
Newbiggen's Hand Book for Gas Engineers, 5th Ed., 1887..
Technical Gas Analysis, Winkler and Lunge .....
Gas Fitter's Question Book with Answers, donated by Albert Dunbar .....
Gas Works, Hughes, donated by J. B. Howard, Galena, Ill.
The Theory of the Gas Engine, Clark, donated by J. B. Howard, Galena, Ill .....
Peckston on Oil and Coal Gas, donated by J. B. Howard, Galena, Ill .....
Consumers' Guide, Richards, donated by J. B. Howard, Galena, Ill .....

GAS WORKS.

No. Vols.

Guide Framing of Gas Holders, Cripps, 1889 1
Their Arrangement Construction, Plant and Machinery, Coyler, 1884..... 1

MISCELLANEOUS.

Annual Report Bureau of Gas, Philadelphia, 1894-1895, Thompson 2
Descriptive Index Current Engineering Literature, 1884-1891 . 1
Engineering Index, Vol. 2, 1892-1895 1
Coal, Gas and Iron Interests, Western Penn., F. L. Slocum, 1895..... 1
Local Engineering Data for St. Louis 1
Laclede Gas Light Company, 1894 1
Monetary Systems of the World, Muhleman 1
Municipal Public Service Industries, Foote..... 1
Plain and Solid Geometry, Wentworth 1
Popular Scientific Recreations, Tissander 1
Reed's Parliamentary Rules..... 1
Speeches and Addresses, Thomas Newbiggin..... 1
The Other Way, Ernest Forbes..... 1
Brown's Directory of American Gas Companies, for 1899, 1900-1-2-3-4..... 6
Brown's Directory, 2 Vol. 1894-1899, donated by J. B. Howard, Galena, Ill..... 2
Holyoke Water Power Co., vs. City of Holyoke, Vols. 1 to 19 donated by Holyoke Water Co., Holyoke, Mass.....14
Ure's Dictionary, 2 Vol., donated by J. B. Howard, Galena, Ill 2
Gas Consumers' Guide, Moore, donated by J. B. Howard, Galena, Ill..... 1
Gas Flow Computer, by Wm. Cox 1
High Pressure Fluid Discharge Computer, by Wm. Cox..... 2

MUNICIPAL OWNERSHIP.

Private Corporation vs. Municipal Ownership, by M. J. Francisco, donated by A. H. Barret, Louisville, Ky..... 1

PHYSICS.

Elements of Physics, A. P. Gage, 1894..... 1

PERIODICALS.

	No. Vols.
American Gas Light Journal, 1892, 1904	23
Light, Heat and Power, 1892-3-4	2
Journal of the Association of Engineering Societies, 1891, 1897	8
Progressive Age, 1890, 1899, 1902	14
American Gas Light Journal, 3 Vol., donated by J. B. Howard, Galena, Ill	1-2 3
Progressive Age, 1900-1-2-3, donated by James W. Dunbar, New Albany, Ind	4

PAMPHLETS.

Coal and Coal Consumption in Spanish America	1
Gas in Foreign Countries, Consular Reports, 1891	1
Practical Hints on the Use and Abuse of Artificial Light	1
Water Gas, J. F. Bell, 1889	1
Water Gas in Small Works	1

STEAM.

Steam, Its Generation and Use, Babcock and Wilcox, 29th Ed., 1896	1
The Locomotive, 1887-8-9, 1890-1-2-3-4	8

TREATISE.

On Heat, Thomas Box, 7th Ed., 1891	1
Traite Pratique De Los Fabrication Du Gaz	1
On Industrial Photometry, Palez	1
On Masonry Construction, Baker, 4th Ed., 1890	1
On Coke, Fulton	1
Clegg on Coal Gas, 2nd Ed., 1853	1
King's Treatise on Coal Gas, Newbiggin	3
Clegg on Coal Gas, 2nd Ed., 1853, donated by J. B. Howard, Galena, Ill	1
Clegg on Coal Gas, 3rd Ed., 1859, donated by J. B. Howard, Galena, Ill.	1
Instructions for Management of Gas Works, Holmes, donated by J. B. Howard, Galena, Ill	1
Setting and Working Retorts, Cathels, donated by J. B. Howard, Galena, Ill	1
Bowditch on Coal Gas, donated by J. B. Howard, Galena, Ill.	1
Gas Managers' Hand Book, Newbiggin, donated by J. B. Howard, Galena, Ill	1

To the Western Gas Association:

I,_____desire to become an_____member of your Association, and respectfully submit this Application therefor.

Dated_____190__

Name_____

Residence_____

Occupation _____

We hereby approve and endorse the above application for _____ Membership in the Western Gas Association.

_____
_____ } Members.

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